

# METROPOLITAN WATER AND SEWERAGE BOARD

---

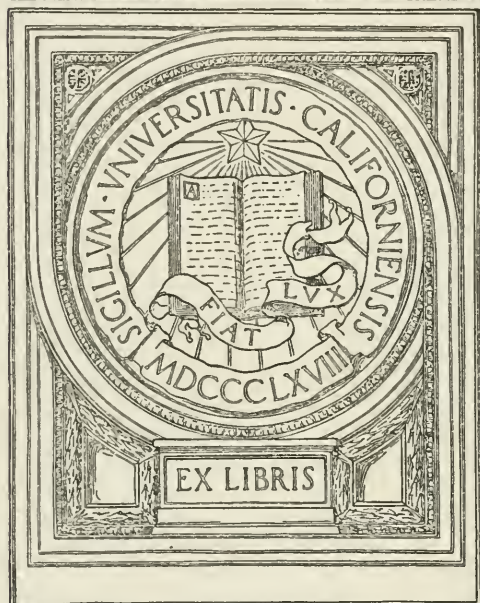
SEVENTH ANNUAL REPORT

DECEMBER 31, 1907

T 30  
225  
B6M32  
1907

ARTHUR D. BUZBY, C. E.

UNIVERSITY OF CALIFORNIA  
AT LOS ANGELES



EX LIBRIS

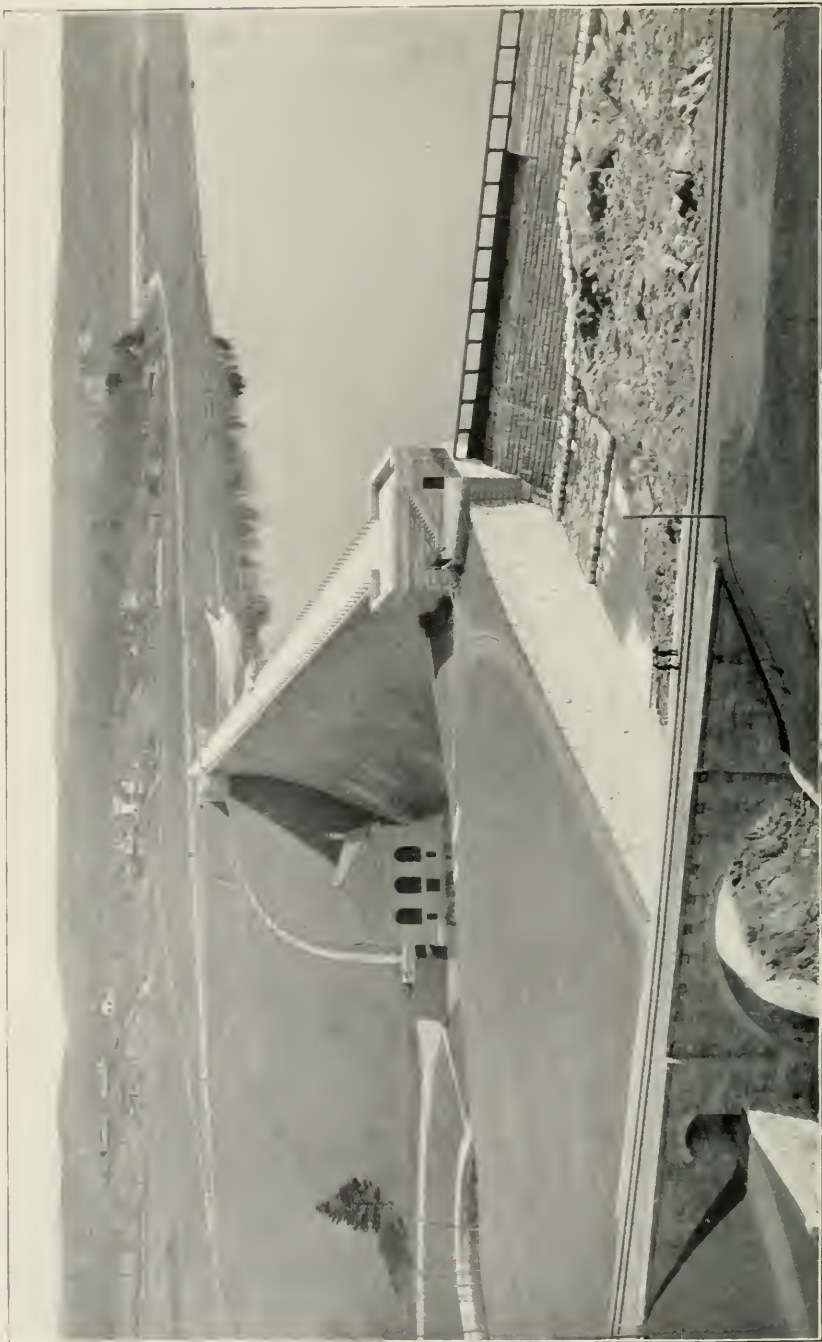
GIFT OF  
MR. C. W. COOK

ARTHUR D. BUZBY, C. E.









WACHUSETT DAM WITH FULL RESERVOIR.

---

---

SEVENTH ANNUAL REPORT

OF THE

METROPOLITAN WATER AND  
SEWERAGE BOARD

FOR THE YEAR 1907.



BOSTON:  
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,  
18 POST OFFICE SQUARE.  
1908.

APPROVED BY  
THE STATE BOARD OF PUBLICATION.

AMERICAN BOOK CO.  
NEW YORK, N. Y.

# CONTENTS.

	PAGE
I. Organization and Administration, . . . . .	1
(1) Board, Officers and Employes, . . . . .	1
(2) Offices and Buildings, . . . . .	4
(3) Conveyancing, . . . . .	4
II. Metropolitan Water District, . . . . .	5
III. Metropolitan Water Works, Construction, . . . . .	5
(1) Wachusett Dam and Reservoir, . . . . .	6
(a) Wachusett Dam, . . . . .	6
(b) Wachusett Reservoir, . . . . .	6
(c) Location, Construction and Discontinuance of Roads, . . . . .	7
(d) Clinton Catholic Cemetery, . . . . .	8
(e) Engineering Work about Wachusett Reservoir, . . . . .	8
(2) Improvement of Wachusett Watershed, . . . . .	9
(a) Sterling Filter-beds, . . . . .	9
(b) Sterling Junction Filter-beds, . . . . .	9
(c) Drainage of Swamps, . . . . .	9
(d) Miscellaneous Improvements, . . . . .	10
(3) Pumping Stations, . . . . .	10
(a) Chestnut Hill Pumping Station, . . . . .	10
(b) Arlington Pumping Station, . . . . .	10
(4) Improvement of Spot Pond Brook, . . . . .	11
(5) Acquisition of Lands and Settlements for Lands acquired, . . . . .	11
(6) Claims and Settlements for Loss of Business, . . . . .	17
(7) Claims and Settlements for Loss of Employment, . . . . .	17
(8) Claims and Settlements for Depreciation of Real Estate, . . . . .	17
(9) Claims on Account of Diversion of Water, . . . . .	18
IV. Water Works, Maintenance, . . . . .	18
(1) Operation of Works, . . . . .	18
(2) Storage Reservoirs, . . . . .	19
(3) Distributing Reservoirs, . . . . .	23
(4) Aqueducts, . . . . .	23
(5) Pumping Stations, . . . . .	24
(6) Pipe Lines, . . . . .	26
(7) Sewerage and Filtration Works, . . . . .	26
(a) Clinton Sewerage Works, . . . . .	26
(b) Marlborough Brook Filter-beds, . . . . .	27
(c) Pegan Brook Filtration Works, . . . . .	28
(8) Sanitary Inspection and Work, . . . . .	28
(9) Forestry, . . . . .	32
(10) Moth Suppression, . . . . .	33
(11) Quality of the Water, . . . . .	34
(12) The Water Supply, . . . . .	34
V. Water Works, Financial Statement, . . . . .	36
(1) Metropolitan Water Loans, Receipts and Payments, . . . . .	37
(2) Issues of Metropolitan Water Loan Bonds, . . . . .	37
(3) Metropolitan Water Loan Sinking Fund, . . . . .	38
(4) Annual Assessments and Receipts, . . . . .	38
(5) Supplying Water to Cities and Towns Outside of District and to Water Companies, . . . . .	39
(6) Expenditures for the Different Works, . . . . .	40
(7) Detailed Financial Statement under Metropolitan Water Act, . . . . .	43
(a) Expenditures and Disbursements, . . . . .	43
(b) Receipts, . . . . .	49
(c) Assets, . . . . .	50
(d) Liabilities, . . . . .	50

	PAGE
VI. Metropolitan Sewerage Works, . . . . .	51
(1) North Metropolitan Sewerage System, Construction, . . . . .	52
(a) Malden Extension Sewer, . . . . .	52
(b) Construction of Bulkhead and filling of Chelsea Street Flats, . . . . .	52
(2) South Metropolitan Sewerage System, Construction, . . . . .	52
(a) Extension of the High-level Sewer, . . . . .	52
(b) Quincy Pumping Station, . . . . .	53
(3) Acquisition of Lands and Settlements for Lands acquired, . . . . .	54
(4) North Metropolitan System, Maintenance, . . . . .	55
(5) South Metropolitan System, Maintenance, . . . . .	56
VII. Sewerage Works, Financial Statement, . . . . .	57
(1) Metropolitan Sewerage Loans, Receipts and Payments, . . . . .	58
(a) North Metropolitan System, . . . . .	59
(b) South Metropolitan System, . . . . .	59
(2) Issues of Metropolitan Sewerage Loan Bonds, . . . . .	59
(3) Metropolitan Sewerage Loans Sinking Fund, . . . . .	61
(4) Annual Appropriations, Receipts and Expenditures, . . . . .	62
(5) Annual Assessments, . . . . .	62
(6) Expenditures for the Different Works, . . . . .	63
(7) Detailed Financial Statement, . . . . .	65
(a) Expenditures and Disbursements, . . . . .	66
(b) Receipts, . . . . .	69
(c) Assets, . . . . .	70
(d) Liabilities, . . . . .	70
VIII. Consumption of Water, . . . . .	71
IX. Electrolysis, . . . . .	74
X. Legislative Acts of the Year 1907, . . . . .	75
XI. Recommendations for Additional Water and Sewerage Loans, . . . . .	76
XII. Sewerage and Water Assessments, . . . . .	81
XIII. Future Work, . . . . .	82
<hr/>	
Report of the Chief Engineer of Water Works, . . . . .	85
Organization, . . . . .	85
Arrangement of Report, . . . . .	86
Construction, . . . . .	86
General Statement, . . . . .	86
Wachusett Reservoir and Dam, . . . . .	87
North Dike, . . . . .	87
Soil Stripping, . . . . .	90
Cleaning of the Reservoir Bottom, . . . . .	91
Shore Protection, . . . . .	91
Work at Wachusett Dam, . . . . .	92
Miscellaneous, . . . . .	93
Improvement of Wachusett Watershed, . . . . .	93
Drainage of Swamps, . . . . .	93
Sterling Filter-beds, . . . . .	95
Sterling Junction Filter-beds, . . . . .	96
Miscellaneous Work, . . . . .	97
Arlington Pumping Station, . . . . .	97
Additional Boiler at the Chestnut Hill High-service Station, . . . . .	100
Engineering, . . . . .	100
Maintenance, . . . . .	101
Rainfall and Yield, . . . . .	101
Storage Reservoirs, . . . . .	101
Sources from which Water has been taken, . . . . .	108
Aqueducts, . . . . .	109
Wachusett, . . . . .	109
Sudbury, . . . . .	109
Cochituate, . . . . .	110
Weston, . . . . .	111

# CONTENTS.

V

## Report of the Chief Engineer of Water Works—*Concluded.*

PAGE

### Maintenance—*Concluded.*

Pumping Stations, . . . . .	111
Chestnut Hill High Service, . . . . .	113
Chestnut Hill Low Service, . . . . .	114
Spot Pond, . . . . .	115
Arlington, . . . . .	116
West Roxbury, . . . . .	117
Consumption of Water, . . . . .	117
Quality of the Water, . . . . .	121
Sanitary Inspection, . . . . .	123
Swamp Ditches and Brooks, . . . . .	127
Forestry, . . . . .	128
Distributing Reservoirs, . . . . .	131
Weston Reservoir, . . . . .	131
Chestnut Hill Reservoir, . . . . .	131
Waban Hill Reservoir, . . . . .	131
Forbes Hill Reservoir and Standpipe, . . . . .	132
Spot Pond, . . . . .	132
Mystic Reservoir, . . . . .	132
Fells and Bear Hill Reservoirs, . . . . .	132
Arlington Standpipe, . . . . .	132
Mystic Lake, . . . . .	133
Pipe Lines, . . . . .	133
Venturi Meters, . . . . .	134
Pressure Regulators and Recording Gages, . . . . .	134
Electrolysis, . . . . .	134
Gypsy and Brown-tail Moths, . . . . .	139
Clinton Sewerage, . . . . .	141
Engineering, . . . . .	144

---

Report of Chief Engineer of Sewerage Works, . . . . .	146
Organization, . . . . .	146
Metropolitan Sewerage Districts, . . . . .	147
Areas and Populations, . . . . .	147
Metropolitan Sewers, . . . . .	148
Sewers purchased and constructed and their Connections, . . . . .	148
Cost of Construction, . . . . .	149
Pumping Stations and Pumpage, . . . . .	150
Construction, . . . . .	151
North Metropolitan System, . . . . .	151
Extension of the Metropolitan Sewer in the City of Malden, . . . . .	151
Timber Bulkhead in Chelsea Creek, . . . . .	151
South Metropolitan System, . . . . .	152
Extension of the High-level Sewer through West Roxbury, Brookline and Brighton, . . . . .	152
Additional Pumping Plant at Quincy Station, . . . . .	164
Maintenance, . . . . .	165
Scope of Work and Force Employed, . . . . .	165
Capacity and Results, . . . . .	169
North Metropolitan System, . . . . .	169
Deer Island Pumping Station, . . . . .	169
East Boston Pumping Station, . . . . .	170
Charlestown Pumping Station, . . . . .	171
Alewife Brook Pumping Station, . . . . .	172
South Metropolitan System, . . . . .	173
Ward Street Pumping Station, . . . . .	173
Quincy Pumping Station, . . . . .	174
Nut Island Screen House, . . . . .	174
Cost of Pumping, . . . . .	175
South Metropolitan Outfalls, . . . . .	177
Material Intercepted at the Screens, . . . . .	178



	PAGE
Appendix No. 1.—Contracts relating to the Metropolitan Water Works made and pending during the Year 1907, . . . . .	180
Appendix No. 2.—Tables relating to the Maintenance of the Metropolitan Water Works, . .	183
Table No. 1.—Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works in 1907, . . . . .	183
Table No. 2.—Rainfall in Inches at Jefferson, Mass., in 1907, . . . . .	184
Table No. 3.—Rainfall in Inches at Framingham, Mass., in 1907, . . . . .	185
Table No. 4.—Rainfall in Inches at Chestnut Hill Reservoir in 1907, . . . . .	186
Table No. 5.—Rainfall in Inches on the Wachusett Watershed, 1897 to 1907, . . . . .	188
Table No. 6.—Rainfall in Inches on the Sudbury Watershed, 1875 to 1907, . . . . .	189
Table No. 7.—Yield of the Wachusett Watershed in Gallons per Day per Square Mile from 1897 to 1907, . . . . .	190
Table No. 8.—Yield of the Sudbury Watershed in Gallons per Day per Square Mile from 1875 to 1907, . . . . .	191
Table No. 9.—Wachusett System.—Statistics of Flow of Water, Storage and Rainfall in 1907, . . . . .	194
Table No. 10.—Sudbury System.—Statistics of Flow of Water, Storage and Rainfall in 1907, . . . . .	195
Table No. 11.—Cochituate System.—Statistics of Flow of Water, Storage and Rainfall in 1907, . . . . .	196
Table No. 12.—Elevations of Water Surfaces of Reservoirs above Boston City Base at the Beginning of Each Month, . . . . .	197
Table No. 13.—Sources from which and Periods during which Water has been drawn for the Supply of the Metropolitan Water District, . . . . .	198
Table No. 14.—Average Daily Quantity of Water flowing through Aqueducts in 1907, by Months, . . . . .	200
Table No. 15.—Statement of Operations of Engines Nos. 1 and 2 at Chestnut Hill High-service Pumping Station for the Year 1907, . . . . .	201
Table No. 16.—Statement of Operations of Engine No. 3 at Chestnut Hill High-service Pumping Station for the Year 1907, . . . . .	202
Table No. 17.—Statement of Operations of Engine No. 4 at Chestnut Hill High-service Pumping Station for the Year 1907, . . . . .	203
Table No. 18.—Statement of Operations of Engines Nos. 5, 6 and 7 at Chestnut Hill Low-service Pumping Station for the Year 1907, . . . . .	204
Table No. 19.—Statement of Operations of Engines Nos. 8 and 9 at Spot Pond Pumping Station for the Year 1907, . . . . .	205
Table No. 20.—(Meter Basis) Average Daily Consumption of Water in Cities and Towns supplied Wholly or in Part by the Metropolitan Water Works, . . . . .	206
Table No. 21.—(Meter Basis) Average Daily Consumption of Water from the Low-service System, . . . . .	206
Table No. 22.—(Meter Basis) Average Daily Consumption of Water from the High-service and Extra High-service Systems, . . . . .	207
Table No. 23.—Average Daily Consumption of Water in Cities and Towns supplied from Metropolitan Works, as measured by Venturi Meters in 1907, . . . . .	208
Table No. 24.—(Pump Basis) Consumption of Water in the Metropolitan Water District, as constituted in the Year 1907, the Town of Swampscott and a Small Section of the Town of Saugus, from 1893 to 1907, . . . . .	211
Table No. 25.—Chemical Examinations of Water from the Wachusett Reservoir, Clinton, . . . . .	212
Table No. 26.—Chemical Examinations of Water from the Sudbury Reservoir, . . . . .	214
Table No. 27.—Chemical Examinations of Water from Spot Pond, Stoneham, . . . . .	215
Table No. 28.—Chemical Examinations of Water from Lake Cochituate, . . . . .	216
Table No. 29.—Chemical Examinations of Water from a Tap at the State House, Boston, . . . . .	217
Table No. 30.—Averages of Examinations of Water from Various Parts of the Metropolitan Water Works in 1907, . . . . .	218
Table No. 31.—Chemical Examinations of Water from a Faucet in Boston from 1892 to 1907, . . . . .	219
Table No. 32.—Colors of Water from Various Parts of the Metropolitan Water Works in 1907, . . . . .	220
Table No. 33.—Temperatures of Water from Various Parts of the Metropolitan Water Works in 1907, . . . . .	221
Table No. 34.—Temperatures of the Air at Three Stations on the Metropolitan Water Works in 1907, . . . . .	222

# CONTENTS.

vii

## Appendix No. 2.—*Concluded.*

Table No. 35.—Table showing Length of Main Lines of Water Pipes and Connections owned and operated by Metropolitan Water and Sewerage Board, and Number of Valves set in Same, Dec. 31, 1907, . . . . .	223
Table No. 36.—Statement of Cast-iron Hydrant, Blow-off and Drain Pipes owned and operated by Metropolitan Water and Sewerage Board, Dec. 31, 1907, . .	224
Table No. 37.—Length of Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works, . . . . .	225
Table No. 38.—Number of Service Pipes, Meters and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works, . . . . .	226
Table No. 39.—Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, to which Water rose, at Different Stations on the Metropolitan Water Works, . . . . .	227
Appendix No. 3.—Water Works Statistics for the Year 1907, . . . . .	229
Appendix No. 4.—Contracts relating to the Metropolitan Sewerage Works, made and pending during the Year 1907, . . . . .	232
Appendix No. 5.—Financial Statement presented to the General Court on January 15, 1908, . . . . .	237
Appendix No. 6.—Legislation of the Year 1907 affecting the Metropolitan Water and Sewerage Board, . . . . .	241

## LIST OF ILLUSTRATIONS.

Wachusett Dam with Full Reservoir, . . . . .	Frontispiece.
Wachusett Reservoir—View from Northwesterly End of the Wachusett Dam, . . . .	6
Arlington Pumping Station—Metropolitan Water Works, . . . . .	10
Improvement of Snake Brook near Lake Cochituate, . . . . .	30
Sewer Construction in Trench on Columbia Street, Brookline—High-level Sewer Extension, . . . . .	53
Diagram showing Average Rate of Consumption of Water in the Metropolitan District in 1907 during the Entire Day and between the Hours of 1 and 4 at Night, . . . . .	72
42-inch Water Pipe in Chelsea pitted by Electrolysis, . . . . .	74
Steel Forms for placing Concrete Masonry Lining in Tunnel—High-level Sewer Extension, . . . . .	80
Filter-beds in Sterling on Wachusett Watershed, . . . . .	96
Diagram showing Average Rate of Consumption in Metropolitan Water District and Average Temperature of Air at Chestnut Hill Reservoir for Each Week during 1907, . . . .	120
Method of supporting Roof Plates in Tunnel Heading—Construction by Compressed Air on High-level Sewer Extension, . . . . .	152
Air Lock at Tunnel Heading—Construction by Compressed Air on High-level Sewer Extension, . . . . .	154
Trench Machine in Operation on Cypress Street, Brookline—High-level Sewer Extension, . . . . .	156



# METROPOLITAN WATER AND SEWERAGE BOARD.

---

*To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.*

The Metropolitan Water and Sewerage Board, established under the provisions of chapter 168 of the Acts of the year 1901, has already presented to your Honorable Body an abstract of the account of its doings, receipts, expenditures, disbursements, assets and liabilities for the fiscal year ending on November 30, 1907, and now, in accordance with the provisions of chapter 235 of the Acts of the year 1906, it presents a detailed statement of its doings for the calendar year ending on December 31, 1907, being its

## SEVENTH ANNUAL REPORT

made since the consolidation of the Metropolitan Water Board and the Board of Metropolitan Sewerage Commissioners on March 20, 1901.

### I. ORGANIZATION AND ADMINISTRATION.

#### (1) BOARD, OFFICERS AND EMPLOYÉS.

The term of office of James A. Bailey, Jr., expired on March 21, 1907, and he was reappointed for the three years next succeeding. The membership of the Board has consequently remained as in the preceding year: Henry H. Sprague, chairman, Henry P. Walcott, M.D., and James A. Bailey, Jr. William N. Davenport has continued as secretary and in charge of the auditing department. Alfred F. Bridgman has been the purchasing agent, and Miss Bertha M. Briggs the book-keeper.

There are also employed in the administrative office a paymaster, an assistant in auditing, two general clerks, three stenographers and clerks, a telephone operator, a messenger, and a janitor with two assistants, one of whom acts as watchman.

George D. Bigelow has been in charge of the conveyancing work, and he has been assisted by Miss Alline E. Marcy, title examiner. They have performed such general conveyancing work, and such further investigation of real estate titles in the different counties as has been called for during the year.

Frederic P. Stearns continued to hold the position of Chief Engineer of the Board until February 1, 1907, although, on account of being unable to give more than a part of his time to the Board, much of the active supervision had devolved upon Dexter Brackett, the Engineer of the Sudbury and Distribution departments. On that date Mr. Stearns' resignation as Chief Engineer was accepted.

In recognition of his services, the Board caused the following entry to be made upon its records:—

The members of the Board, in regretfully accepting the resignation of Mr. Stearns as Chief Engineer, desire to express and record their appreciation of the value and excellence of his service in connection with the Metropolitan Water Works. Having assisted as Engineer of the State Board of Health in the inception of the scheme for securing to the District an additional water supply, he entered upon his service with a ripe experience; he displayed rare foresight and wisdom in the maturing of the plans for carrying out the undertaking; and he prosecuted the details of construction with zeal and fidelity until the greater works contemplated for the earlier period, which has now elapsed, have been successfully completed. For the intelligence, skill and devotion which he constantly exercised, and for the thoroughness, economy and efficiency which he achieved, the Commonwealth owes him a deep obligation.

Mr. Stearns was at the same time made a consulting engineer of the Board, and is retained with Joseph P. Davis and Hiram F. Mills for consultation in such matters as may arise requiring consideration.

Dexter Brackett was appointed Chief Engineer of Water Works, with supervision of the various departments. William E. Foss and Alfred O. Doane have continued as Division Engineers, Benjamin F. Hancox as Assistant in charge of the Drafting Department, and Samuel E. Killam as Office Assistant.

There has been a slight reduction in the engineering force employed in construction upon the Water Works, but some addition has been required in the number employed upon the maintenance and operation of works. The average force in construction and maintenance during the year has included, in addition to the Chief Engineer, 5 division

engineers, 6 assistant engineers, and 36 others in various engineering capacities and as sanitary inspectors, clerks, stenographers and messengers, the total force numbering 47. The maximum engineering force employed at any one time during the year on both construction and maintenance was 50.

A maintenance force, in addition to those engaged in engineering capacities as above mentioned, numbering upon the average during the year 234, has been required at the pumping stations and upon the reservoirs, aqueducts, pipe lines and other works. At the end of the year this force numbered 203.

Day laborers have in addition been employed from time to time in connection with the regular force as their services were required.

William M. Brown has continued in charge of both construction and maintenance of the Sewerage Works during the year. On February 1, 1907, his title was changed to that of Chief Engineer of Sewerage Works. He has been assisted during the year by Frank I. Capen, Seth Peterson, Frederick D. Smith and Frank A. Emery (part of the year), division engineers, who have been in supervision of both construction and maintenance departments, by 5 assistant engineers and 22 others employed in various engineering capacities, and by one clerk and stenographer.

The maximum engineering force employed at any one time during the year on construction and maintenance of Sewerage Works was 28.

The regular maintenance force required in addition for the operation of the pumping stations, the care and inspection of the sewers and for other parts of the Sewerage Works, exclusive of the engineers and day-labor forces, has upon the average numbered 140.

The whole regular force of the Sewerage Department at the end of the year numbered 168, of whom the Chief Engineer and 27 assistants and draftsmen were engaged in general upon the works, and, of the remainder, 83 were employed upon the North System and 57 upon the South System.

Day-labor forces under the supervision of the engineers and the immediate direction of foremen have been employed in the construction of the pneumatic tunnel on Section 80 of the High-level Sewer extension in West Roxbury and in the construction of a rock and earth tunnel in Brighton on Section 85.



The maximum number of men employed upon contracts and upon day-labor construction on the Sewerage Works during the year was for the week ending August 10, when the number amounted to 468.

## (2) OFFICES AND BUILDINGS.

The offices of the Board and of the secretary, the auditing and conveyancing departments, and the main engineering offices of both Water Works and Sewerage Works are located in the buildings numbered 1 and 3 Ashburton Place, at the corner of Somerset Street.

A branch office for the Wachusett Department of the Water Works is maintained at Clinton, and for the Sudbury Department at South Framingham. Headquarters of the maintenance force of the Water Works for the northern part of the Metropolitan District are maintained in the Glenwood pipe yard in Medford, where there are offices, shops, store-rooms and stables; and the maintenance force for the southern part of the District has headquarters in like buildings at the Chestnut Hill Reservoir.

Branch headquarters of the maintenance and repair forces of the Sewerage Works are maintained for the North Metropolitan System near the East Boston pumping station, and for the South Metropolitan System at the Ward Street pumping station and at the storage yard at Hough's Neck.

## (3) CONVEYANCING.

The conveyancing work required for the Water and Sewerage Works has occupied but a part of the time of the conveyancer and his assistant.

The settlements made by the Board affecting real estate were 52 in number, and have called for the revision and bringing up to date of the titles involved and the preparation of the various papers which have been required. Of these settlements, 17 were on account of lands and easements acquired by the Board, and these affected a total area of 46.58 acres.

Examination of the titles of 19.10 acres of additional land acquired during the year has been required, and besides 12 instruments of taking have been drafted and recorded. Of these takings, 7 were



for the Water Works and covered land which had been previously acquired by deed, amounting in all to about 347.62 acres. The 5 takings of land for the Sewerage Works were for the High-level Sewer extension in Brookline, and they amounted in fee and in easements to 12.66 acres, none of which had been previously acquired.

## II. METROPOLITAN WATER DISTRICT.

The Metropolitan Water District now comprises the cities of Boston, Chelsea, Everett, Malden, Medford, Melrose, Newton, Quincy and Somerville, and the towns of Arlington, Belmont, Hyde Park, Lexington, Milton, Nahant, Revere, Stoneham, Watertown and Winthrop, — in all, 9 cities and 10 towns. The District has an area of 171.7 square miles, and its population, as of the date of July 1, 1907, — the date upon which calculations for the Water Works are based, — is estimated at 980,900.

The town of Swampscott, having an estimated population of 5,510, although it is outside of the Metropolitan Water District, is supplied with water by a special arrangement made with the Board.

The city of Newton and the town of Hyde Park, however, though belonging to the District, do not take water from the Metropolitan sources, but still depend upon their own sources of supply.

## III. METROPOLITAN WATER WORKS — CONSTRUCTION.

The total amount expended for construction, including real estate acquired and payment of claims on account of the Water Works, during the calendar year 1907, was \$188,631.02. Of this amount, \$99,592.35 was expended on account of the Wachusett Dam and Reservoir; \$3,359.13 on account of the Weston Aqueduct and Reservoir; \$19,370.72 for the improvement of the Wachusett watershed; \$3,391.30 on account of the diversion of the waters of the South Branch of the Nashua River; \$56,199.06 for construction in the Distribution Department; and the remainder, \$6,718.46, for administration and other expenses. The total amount expended on account of construction since the beginning of the Water Works in the year 1895 has been \$40,467,508.04.

## (1) WACHUSETT DAM AND RESERVOIR.

(a) *Wachusett Dam.*

A small amount of construction work has been done during the past year in connection with the Wachusett Dam.

Machinery for lighting, pumping and hoisting in the gate or power house has been obtained and set up in the house. The temporary wooden floor in the main room has been raised to its permanent level, but it is not contemplated to construct a permanent tile floor until the power plant, if determined upon, shall be installed. Appliances have been introduced for measuring and recording the amounts of water flowing into the Lancaster Mills pond and furnished to the Lancaster Mills. Some work has been done in pointing the joints of the up-stream face of the dam.

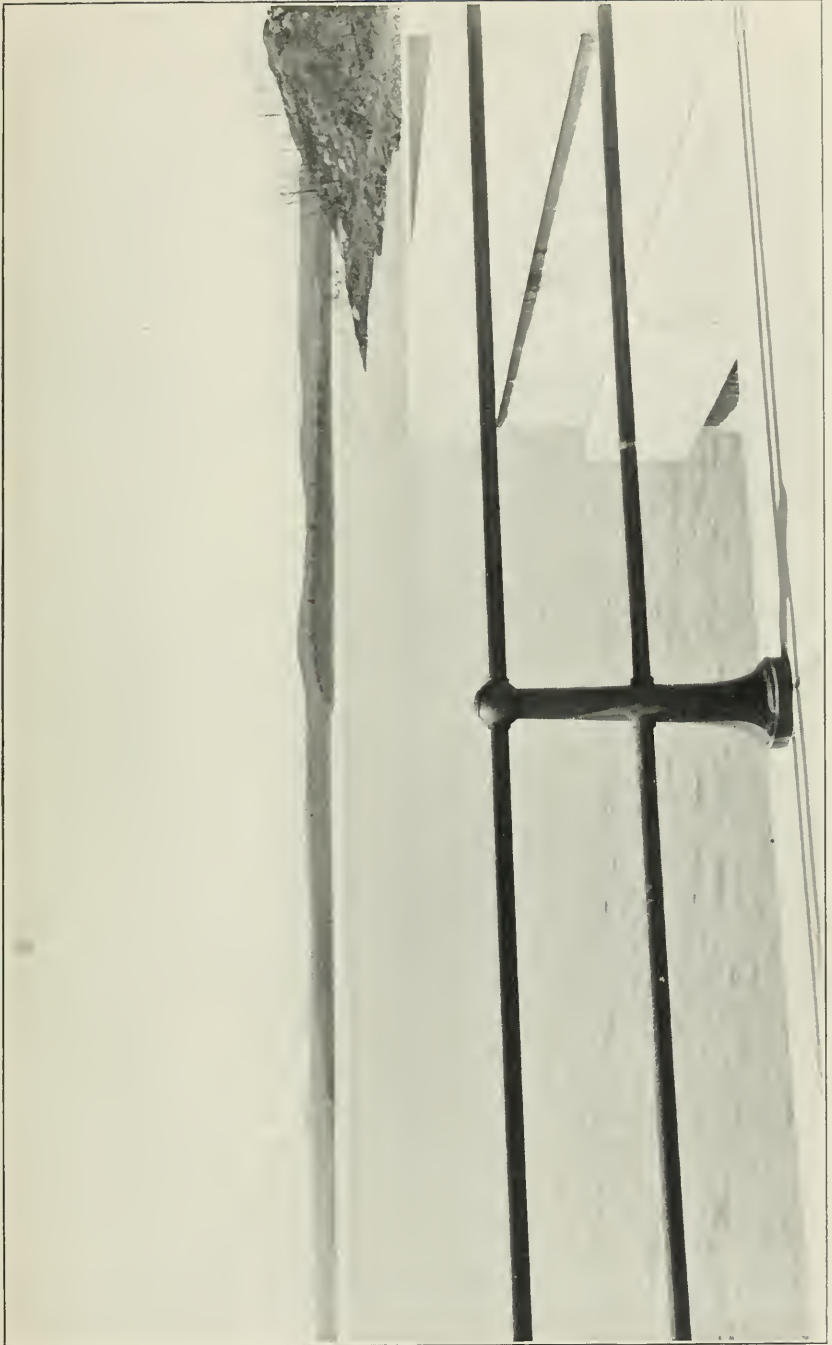
(b) *Wachusett Reservoir.*

In anticipation of the complete filling of the reservoir, it was deemed necessary to remove the weeds, grass and shrubs which had grown up, since the original stripping of the bed of the reservoir, upon the upper portions of the reservoir site where the water had not yet reached. There was thus cleaned up an area of about 1,130 acres.

The rising of the water of the reservoir, in connection with the action of the wind and rain and frost, has caused a caving in of the steeper banks in several places along the shores, and a consequent retreating of the margin to the original limit of the soil stripping. In such places further cleaning and removal of the soil have been found necessary, and for a total distance of about 4,600 feet the organic material has been further removed to a width of from 10 to 40 feet.

The steep bank on the northwesterly side of the reservoir beyond the waste-way of the dam, which had been covered with gravel, has been further protected from the action of the waves by the laying of riprap for a distance of about 265 feet.

On April 11 there occurred at the North Dike a slide of a portion of the material, composed of sand, gravel and riprap, which constitutes the facing or embankment sloping toward the reservoir. The portion of the dike affected was about 700 feet long, where the dike is about 80 feet high and has a thickness at the base of 1,930 feet.



WACHUSETT RESERVOIR—VIEW FROM NORTHWESTERLY END OF THE WACHUSETT DAM.



This facing, which had been placed of varying thicknesses against the water-tight core of the dike, had at this point a slope of 2 horizontal to 1 vertical, and the water had thus far risen against it to a depth of about 42 feet. The slide did not affect the stability of the dike proper, but did show the importance of lengthening the slope of the outer gravel facing approximating to that which is made by the natural action of the water.

It was therefore deemed advisable in making the necessary repairs to reenforce the embankment against the water of the reservoir, not only at the point where the slide occurred, but in other places, by extending the original decline of 2 to 1 to a slope of 4 and 5 horizontal to 1 vertical. The embankment has thus been strengthened at five different points along the westerly portion of the dike, aggregating a length of 1,560 feet. The necessary material was taken from the bed of the reservoir, and the rock for the riprap has been obtained from quarries on the land of the Commonwealth. All the labor has been performed by men and teams employed under the direct supervision of the Superintendent of the Wachusett Department, except for the laying of the heavy riprap, which was done under contract. The entire work had been completed at the end of the year except the laying of a small portion of the riprap. The cost of the work will be apportioned between construction and maintenance, that estimated for reenforcement and strengthening of the dike to construction and the remainder to maintenance.

A map of the completed reservoir, showing the water line and the marginal property line, and the positions of the more prominent points included in the area, has been prepared and accompanies this report.

*(c) Location, Construction and Discontinuance of Roads.*

No new highways have been laid out during the past year, and but one highway has been discontinued, a description of which is as follows:—

*Discontinuance of Road in the Year 1907.*

No.	Location.	Description.	Date of Discontinuance.
27	Sterling,	That part of the road formerly leading from Sawyer's Mills to Sterling, extending northwesterly from the portion of said road already discontinued to the new highway from West Boylston to Clinton.	January 18, 1907.

*(d) Clinton Catholic Cemetery.*

As stated in previous annual reports, all the work required to be done under the agreement made with the Roman Catholic Bishop of the Diocese of Springfield, the St. John's Catholic Cemetery Association of Clinton, and the Board, by which lands were to be acquired in the southerly part of the town of Lancaster for a new cemetery and the bodies were to be removed from the old cemetery to the new cemetery site, has long been accomplished. The soil on the site of the old cemetery was stripped and removed, and the land has been embraced in the reservoir limits, while the new cemetery has long been in general use.

The Board has repeatedly, but without success, asked for the final performance of the stipulations of the agreement, that on the completion of the work the Bishop, who holds the title, shall convey to the Commonwealth the old cemetery lot, with a release of all claims for damages, and thereupon the Board is ready to convey the lands in Lancaster, to which the Commonwealth holds title, to the St. John's Catholic Cemetery Association, and to pay to the Association the balance of money, amounting to \$32,096.83, due from the Commonwealth, all as required by the agreement.

*(e) Engineering Work about Wachusett Reservoir.*

During the past year the survey of the marginal line of the watershed of the Wachusett Reservoir has been completed and the entire area ascertained. The length of the marginal line is determined to be 78.93 miles, and the area of the watershed above the dam to be 118.90 square miles.

Lines have been drawn upon the record plans showing the contour of the area or bottom of the reservoir, completing the work except in the places where there have been recent changes at the shores. Subject to slight revision, the area of the reservoir has been fixed at 4,135.32 acres, or 6.46 square miles, and the capacity of the reservoir has been calculated to be 64,968,000,000 gallons.



## (2) IMPROVEMENT OF WACHUSETT WATERSHED.

*(a) Sterling Filter-beds.*

The four filter-beds designed to divert and filter the waters of a brook which runs through the village of Sterling Centre, whose construction was begun in September, 1906, were completed during the fore part of the past year. They were put into operation on May 23, and since that time the entire water of the brook, which receives the overflow of some of the cesspools in the village, and other polluting matter, has been filtered by passing through the beds. The cost of construction was \$14,221.28, and the sum of \$1,060 was paid for land damages.

*(b) Sterling Junction Filter-beds.*

The sewage and drainage of several summer cottages and a boarding house near the Sterling Methodist Camp Grounds had been conveyed to a cesspool near the West Waushacum Pond, from which there was a frequent overflow, so that polluting matter often found its way into the pond and thence was received into the Wachusett Reservoir. To remedy this trouble four small filter-beds, having a combined area of 1,200 square feet, have been built, and all the drainage from these houses is now filtered before entering the pond and being thence discharged into the reservoir. They were put into operation on September 16, but their maintenance will not be required in the winter months. The cost of construction was \$541.13.

*(c) Drainage of Swamps.*

The construction of ditches for the drainage of the swamp on Governor Brook, situated in the towns of Holden and Princeton and tributary to the Quinepoxet River, had been begun in the preceding year. The work was resumed early in the past year, and was completed near the end of the season.

This swamp has an area of 220 acres and a watershed of about 1,625 acres. The total length of the ditches constructed for its drainage was 27,661 feet, of which 23,064 feet, or 4.37 miles, were built during the past year, at a cost of \$10,647.



The total length of ditches constructed for the drainage of swamps on both Trout and Governor brooks in the two towns in the past two years was 57,812 feet, or 10.95 miles.

(d) *Miscellaneous Improvements.*

The low intervale land along the Quinepoxet River above the reservoir, which is flooded at times of heavy rains, has to the extent of about 14 acres been cleared of the brush and dead and decaying wood, and has been burned over so as to prevent, so far as practicable, the washing of undesirable matter into the reservoir.

At Dorr's Mill and Warfield's Mill, both situated above the reservoir on the Quinepoxet River, properties which have been acquired by the Commonwealth, the remaining walls of buildings have been taken down, the cellars filled or cleaned up, and the grounds put generally into a sanitary condition. The old farmhouse, cottages and barns at the Gates farm on Middle Waushacum Pond have all been taken down and removed. Several cesspools and a vault have been built in the town of Sterling for preventing the pollution by barn, sink and privy drainage of the water flowing into the reservoir.

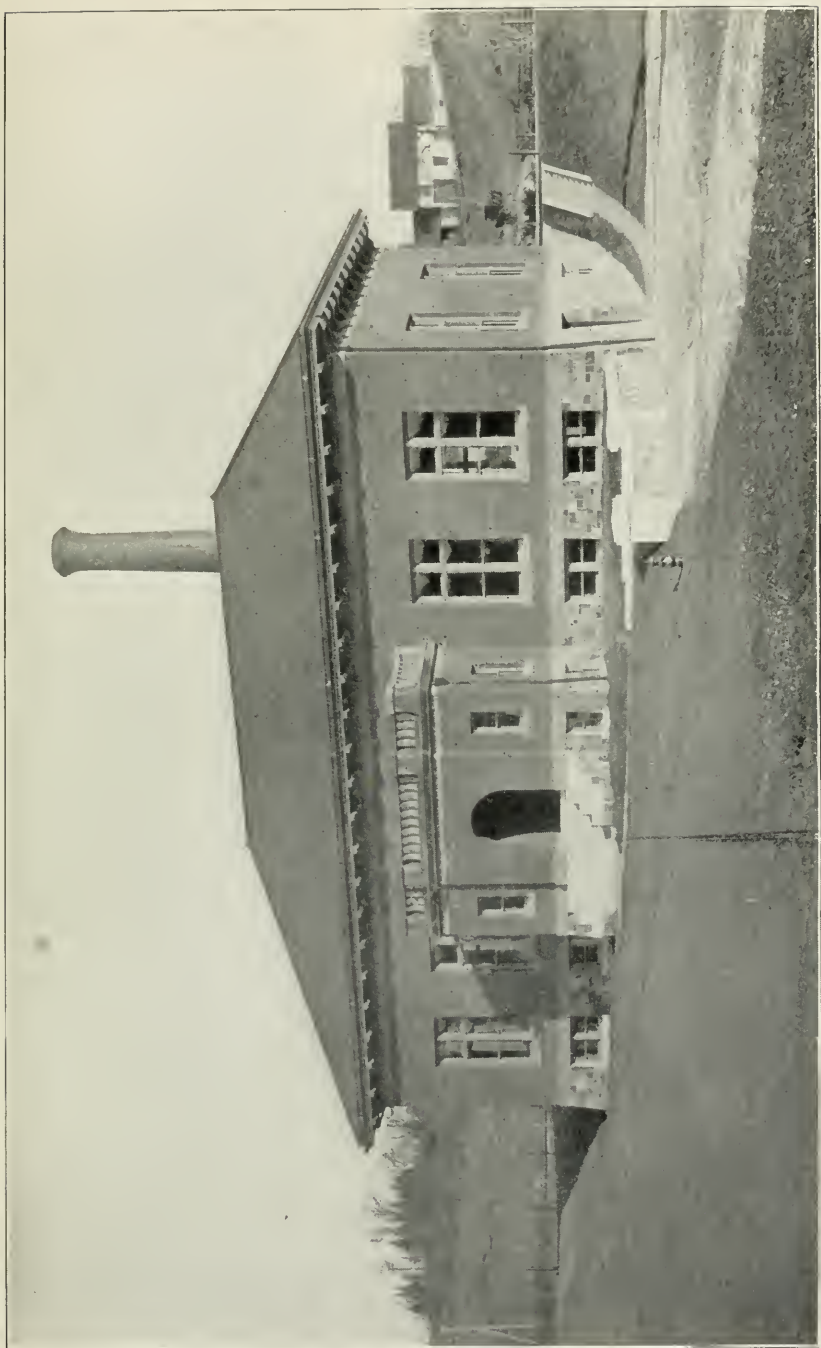
(3) PUMPING STATIONS.

(a) *Chestnut Hill Pumping Stations.*

A new boiler at the Chestnut Hill high-service pumping station, of a design the same as that of the two boilers obtained in the year 1901, was contracted for and has been installed, and has added much to the efficiency of the high service. The cost of the boiler as delivered at the station was \$2,976.

(b) *Arlington Pumping Station.*

The new Arlington pumping station, which had been about half constructed in the year 1906, has been fully completed during the past year. The main building is 90 feet long and 46 feet wide, and has a height of 26 feet from the surface of the ground to the cornice. The foundations are of concrete surmounted with seam-faced granite, and the exterior walls are of dark-red brick with brown-stone trimmings, and are covered with a hip roof. The brick chimney has a height of 70 feet and a diameter of 8 feet at its base. The engine and boiler rooms have interior facings of red brick, the



ARLINGTON PUMPING STATION — METROPOLITAN WATER WORKS.



floor of the former being of red tiles and of the latter granolithic. There are an office and a toilet room, and there is also a large underground coal pocket, over a part of which extends a side track from the main line of the railroad, so that coal may be delivered from the cars directly into the station. Considerable grading of the grounds about the station has been required.

The pumping engine, which had been contracted for, was installed and was put into operation near the end of the year. It had been intended to remove to the new station and to put into operation one of the old pumping engines formerly belonging to the town of Arlington, but it was found that it was incapable of prolonged use, and a contract was made for a second engine. This engine, which has, like the other, a capacity of pumping 1,500,000 gallons per day, will be completed early in the coming year. Two boilers with the necessary settings and connections have been installed.

In making the detailed plans for the building it was determined to be desirable to construct a building of larger size and more stable character than had been originally intended, in order to make a proper provision for the future for the district supplied from the station, which at the present time comprises a portion of the town of Arlington and the town of Lexington. The total cost of the building, machinery and equipment has thus far been \$47,473.95.

#### (4) IMPROVEMENT OF SPOT POND BROOK.

No action has been taken during the year under the petition brought by the city of Melrose for the appointment of commissioners under chapter 406 of the Acts of the year 1904, which was an act "to provide for the improvement of Spot Pond Brook by the Metropolitan Water and Sewerage Board."

#### (5) ACQUISITION OF LANDS AND SETTLEMENTS FOR LANDS ACQUIRED.

The Board acquired during the past year by purchase 19.10 acres in fee, situated in West Boylston, being that part of the Oakdale Park land on the northwesterly side of Pleasant Street which had not been previously acquired by the Board. No new land has been acquired by taking.

The total area of all the lands acquired for the Metropolitan Water Works since the beginning of operations in the year 1895 has

amounted to 16,833.83 acres, or 26.28 square miles. The number of takings of land made during the year was 7, all of land supposed to have been already acquired by deed.

*List of Takings for Metropolitan Water Works for the Year 1907.*

No.	LOCATION AND DESCRIPTION.	Former Owners.	Recorded.	Purpose of Taking.
115	West Boylston,—6 parcels, one on Lancaster Street, one on Lancaster and Sterling streets, one easterly of the southwest end of Lancaster Street, two on opposite sides of the new highway to Oakdale, and one easterly of Worcester Street on the side of the Worcester, Nashua & Rochester Railroad. Area, 74.96 acres, in fee.	Ada A. Whittemore, Mary E. Cook, devisees of Lorenzo Butler, George H. Holmes and Louis W. and Arthur H. Sawyer.	<b>1907.</b> Feb. 7.	Wachusett Reservoir.
116	West Boylston,—the Oakdale Park land on the northwesterly side of Pleasant Street and on the Worcester, Nashua & Rochester Railroad. Area, 19.10 acres, in fee.	Inhabitants of the town of West Boylston.	May 18.	Wachusett Reservoir.
117	Clinton, Sterling and Boylston,—2 parcels in Clinton, one on Prospect and Walnut streets, the other on Boylston Street, a parcel in Sterling on the old road to Sawyer's Mills, and two in Boylston, one on the new highway to Clinton and the other on the old road to Sawyer's Mills and a cross road; also, 2 parcels within adjoining roads. Area, 22.035 acres, in fee.	Walter R. Dame, Thomas Ellis, devisees of Thomas H. O'Connor, George Hazard and Aime Gregoire.	Nov. 29.	Wachusett Reservoir.
118	Framingham, Wayland and Weston,—in Framingham easterly from Edgell Street, in Wayland easterly from School Street, and in Weston on River and Loring streets. Area, 13.52 acres, in fee.	Saxonville Mills, Abbie F. Nogler and Laura S. Wilkinson and others.	Dec. 3.	Weston Aqueduct.
119	Natick,—southerly of Fisher Street on the Saxonville Branch of the Boston & Albany Railroad, with right of way to Fisher Street. Area, 2.95 acres, in fee.	Clement P. Soley.	Dec. 3.	Improvement of Lake Cochituate.
120	Holden,—the "Canada Mills" property on River and Holden streets, and the "Dorr Mills" property on Quinepoxet River and the Boston & Maine Railroad. Area, 204.17 acres, in fee.	The L. M. Harris Manufacturing Company and James Dorr.	Dec. 31.	Improvement of Wachusett Watershed.
121	Sterling and West Boylston,—the Palmer Wagon Company property on Fairbank and Loring streets, and a new highway. Area, 10.88 acres, in fee.	Walter B. Sawyer and William M. Bruce.	Dec. 31.	Improvement of Wachusett Watershed.

Settlements under purchases and takings of land, for all purposes of the Water Works, have been effected in the past year in 14 cases, and for an aggregate of 46.24 acres, with the buildings thereon. Of these cases, 6 were on account of the Wachusett Reservoir, 4 on account of the Weston Aqueduct, 3 for the improvement of the Wachusett watershed, and 1 for the low service pipe line in Med-



ford. The sums paid in all these settlements during the year 1907 have amounted to \$10,829.49. In 3 of these cases the settlements have been results of suits at law, and the total amount paid in the court settlements during the year 1907 has been \$2,240.49. Payments "on account" previously made would make the total amount paid in these 3 cases \$3,518.56.

Since the beginning of operations upon the Metropolitan Water Works, the number of settlements effected on account of the acquisition of lands for the purposes of the Water Works, including the works of water supply acquired from the city of Boston on January 1, 1898, has amounted to 881; and under them the Board has acquired rights, in fee or easements, in 16,538.12 acres, or 25.84 square miles, for which an aggregate of \$18,257,848.72 has been paid. Only 51 of these cases have been settled by judgments obtained in court, and the total amount paid under these judgments has been \$1,390,270.15, or less than 8 per cent. of the whole amount paid.

Of the lands acquired, either in fee or in easement, since the beginning of operations upon the Metropolitan Water Works, settlement has been effected with the owners of all these lands except 2.61 acres. This amount does not, however, include 69.75 acres in Lancaster, which the Board stands ready to convey to the St. John's Catholic Cemetery Association; and 38.79 acres of land in Clinton, of which the owners have not been found.

Not including the settlement with the city of Boston, which was effected by agreement out of court, and the settlement with the cities of Malden, Medford and Melrose for Spot Pond and surrounding lands, which was made upon the basis of an award by commissioners, the Board has obtained settlement by voluntary agreement with  $\frac{17}{18}$  of all the owners of the lands acquired, and almost  $\frac{13}{14}$  of the total amount of money paid in settlements was under voluntary agreement with the owners.

The above purchases and takings for which the settlements have been made include lands taken in fee with the buildings thereon and the water and other rights connected therewith, and lands in which easements and other rights are taken; but they do not include settlements for diversion of water, depreciation and other damages connected with lands not acquired, and in which no fee or easement has been taken.

*Summary of Land Settlements for Water Works to December 31, 1907.*

LOCATION.	FOR THE YEAR 1907.			FROM BEGINNING OF WORK.		
	Area in Acres.	Number of Settlements.	Payments.	Area in Acres.	Number of Settlements.	Payments.
<i>Wachusett Reservoir.</i>						
Berlin, . . . . .	-	6	\$6,679 00	16.700	441	\$2,958,359 10
Boylston, . . . . .	-			4,003.116		
Clinton, . . . . .	1.269			1,276.284		
Holden, . . . . .	-			167.000		
Sterling, . . . . .	-			797.987		
West Boylston, . . . . .	30.573			1,683.497		
Total, . . . . .	31.842	6	\$6,679 00	7,944.584	441	\$2,958,359 10
<i>Improving Wachusett Watershed.</i>						
Holden, . . . . .	-	3	\$1,060 00	151.340	11	\$134,520 00
Sterling, . . . . .	8.590			237.740		
West Boylston, . . . . .	-			64.430		
Total, . . . . .	8.590	3	\$1,060 00	453.510	11	\$134,520 00
<i>Wachusett Aqueduct.</i>						
Berlin, . . . . .	-	-	-	47.815	70	\$81,677 08
Clinton, . . . . .	-			12.310		
Marlborough, . . . . .	-			51.530		
Northborough, . . . . .	-			89.000		
Southborough, . . . . .	-			108.660		
Total, . . . . .	-	-	-	309.315	70	\$81,677 08
<i>Sudbury Reservoir.<sup>1</sup></i>						
Marlborough, . . . . .	-	-	-	751.980	153	\$658,318 75
Southborough, . . . . .	-			2,019.080		
Total, . . . . .	-	-	-	2,771.060	153	\$658,318 75
<i>Improving Sudbury Watershed.</i>						
Ashland, . . . . .	-	-	-	.630	41	\$16,522 16
Marlborough, . . . . .	-			.800		
Northborough, . . . . .	-			173.049		
Sherborn, . . . . .	-			1.000		
Southborough, . . . . .	-			4.829		
Westborough, . . . . .	-			205.487		
Total, . . . . .	-	-	-	390.795	41	\$16,522 16

<sup>1</sup> Including settlements made by city of Boston.



*Summary of Land Settlements for Water Works, etc. — Continued.*

LOCATION.	FOR THE YEAR 1907.			FROM BEGINNING OF WORK.		
	Area in Acres.	Number of Settlements.	Payments.	Area in Acres.	Number of Settlements.	Payments.
<i>Clinton Sewerage System.</i>						
Clinton, . . . . .	-	}	-	5.315	}	\$37,794 40
Lancaster, . . . . .	-		-	129.835		
Total, . . . . .	-	-	-	135.150	36	\$37,794 40
<i>Weston Aqueduct.</i>						
Framingham, . . . . .	4.690	}	\$2,290 49	107.335	}	\$187,161 96
Newton, . . . . .	-			1.308		
Southborough, . . . . .	.360			.810		
Wayland, . . . . .	-			73.299		
Weston, . . . . .	.720	}	\$2,290 49	295.915	}	\$187,161 96
Total, . . . . .	5.770	4	\$2,290 49	478.667	90	\$187,161 96
<i>Distribution System.</i>						
Arlington, . . . . .	-	}	\$800 00	1.896	}	\$172,716 85
Boston, . . . . .	-			1.359		
Brookline, . . . . .	-			.051		
Malden, . . . . .	-			.158		
Medford, . . . . .	.038			3.251		
Newton, . . . . .	-			5.147		
Quincy, . . . . .	-			5.224		
Revere, . . . . .	-			.404		
Somerville, . . . . .	-			.009		
Stoneham, . . . . .	-			19.409		
Total, . . . . .	.038	1	\$800 00	36.908	35	\$172,716 85
<i>Improving Lake Cochituate.</i>						
Natick, . . . . .	-	-	-	2.950	1	\$1,600 00
Total, . . . . .	-	-	-	2.950	1	\$1,600 00
<i>Spot Pond Water Works (Taking of January 1, 1898).</i>						
Medford, . . . . .	-	}	-	.630	}	\$1,214,523 63 <sup>1</sup>
Stoneham, . . . . .	-			216.000		
Total, . . . . .	-	-	-	216.630	1	\$1,214,523 63

<sup>1</sup> Includes \$749.71 paid city of Malden for supplies not part of award.

*Summary of Land Settlements for Water Works, etc. — Concluded.*

LOCATION.	FOR THE YEAR 1907.			FROM BEGINNING OF WORK.		
	Area in Acres.	Number of Settlements.	Payments.	Area in Acres.	Number of Settlements.	Payments.
<i>Spot Pond Improvement (Takings of August 5, 1899, and June 2, 1902).</i>						
Medford, . . . . .	-	}	-	41.447	}	\$23,705 99
Stoneham, . . . . .	-		-	13.100		
Total, . . . . .	-	-	-	54.547	1	\$25,705 99
<i>Boston Water Works<sup>1</sup> (Taking of January 1, 1898).</i>						
Arlington, . . . . .	-	}	-	1.586	}	\$12,768,948 80 <sup>2</sup>
Ashland, . . . . .	-			652.124		
Boston, . . . . .	-			160.630		
Framingham, . . . . .	-			663.460		
Hopkinton, . . . . .	-			654.729		
Marlborough, . . . . .	-			30.552		
Medford, . . . . .	-			25.140		
Natick, . . . . .	-			436.223		
Needham, . . . . .	-			31.695		
Newton, . . . . .	-			78.308		
Sherborn, . . . . .	-			40.385		
Somerville, . . . . .	-			12.426		
Southborough, . . . . .	-			17.168		
Wayland, . . . . .	-			177.875		
Wellesley, . . . . .	-			139.115		
Westborough, . . . . .	-			545.912		
Winchester, . . . . .	-			76.094		
Woburn, . . . . .	-			.578		
Total, . . . . .	-	-	-	3,744.000	1	\$12,768,948 80
Aggregates, . . . . .	46.24	14	\$10,829 49	16,538.116	881	\$18,257,848 72

<sup>1</sup> Estimated areas.<sup>2</sup> Includes interest.

The settlements above enumerated include all lands acquired for which a complete settlement has been made. About 116.05 acres of the lands acquired and settled for have been subsequently sold and conveyed by the Board.

The tables of settlements for lands acquired do not include: —

1. Lands acquired but not paid or settled for, amounting to about 120.13 acres, including 50.77 acres previously owned by the Com-

monwealth and 66.76 acres of other lands for which no claims will probably be made.

2. Lands embraced in the St. John's Catholic Cemetery, comprising 26.39 acres in Clinton and 69.75 acres in Lancaster.

3. Areas of streets.

#### (6) CLAIMS AND SETTLEMENTS FOR LOSS OF BUSINESS.

For injury to business caused by the carrying out of the Metropolitan Water Act in the towns of Boylston and West Boylston and in portions of the towns of Sterling and Clinton, settlements were made during the year in 4 cases, the amount paid being \$756.82.

The number of claims of this class settled since the beginning of the Metropolitan Water Works has been 326, and the total sum paid on account of such claims has been \$153,979.18. All of these claims except 19 have been settled outside of the court.

#### (7) CLAIMS AND SETTLEMENTS FOR LOSS OF EMPLOYMENT.

No claims for loss of employment by residents of West Boylston have been filed during the year. This class of claims seems to be finally disposed of.

The whole number of settlements for such claims effected since the beginning of the operations of the Board has been 477. The total amount paid on account of these claims has been \$85,959.65. All of the claims with the exception of 3 were settled without resort to the courts.

#### (8) CLAIMS AND SETTLEMENTS FOR DEPRECIATION OF REAL ESTATE.

Settlements for depreciation in the value of real estate not taken by the Board were effected in 7 cases, 4 on account of lands situated in the town of West Boylston amounting to \$12,735, and 3 on account of lands situated in Boylston amounting to \$610.40, making a total for the year of \$13,345.40. The 3 Boylston cases were settled in court after trial. All the West Boylston cases were settled by agreement out of court.

The total number of claims for depreciation settled up to December 31, 1907, has been 282, and the total amount paid thereunder has been \$278,804.91. All of these claims except 45 were settled out of court.

### (9) CLAIMS ON ACCOUNT OF DIVERSION OF WATER.

There have been 12 claims settled during the year for damages for the diversion of water, amounting to \$2,360.76, and all were for injuries to meadow lands upon the Nashua River, situated in the towns of Harvard, Lancaster and Bolton. The total sum paid under settlements and judgments arising under claims made on account of the diversion of water, since the beginning of the construction of the Water Works, has been \$1,138,069.67.

The sums enumerated as paid in these and in the preceding cases do not include amounts paid for expert services and court expenses.

## IV. WATER WORKS — MAINTENANCE.

Dexter Brackett, the Chief Engineer of the Water Works, has had general supervision over the maintenance and operation of all the Water Works of the Metropolitan System. He has been assisted by Elliot R. B. Allardice, Superintendent of the Wachusett Department; by Charles E. Haberstroh, Superintendent in charge of the Sudbury and Cochituate Works and of the portion of the Weston Aqueduct above the Weston Reservoir; by George E. Wilde, Superintendent in charge of the Weston Reservoir and the remainder of the Weston Aqueduct, and of all the reservoirs and pipe lines within the Metropolitan District; and by Arthur E. O'Neil, Superintendent of the several pumping stations.

### (1) OPERATION OF WORKS.

The maintenance of the Water Works embraces the care and operation of the five water pumping stations, of the Pegan and Clinton sewerage pumping stations, the ten storage reservoirs, the ten distributing reservoirs, the four aqueducts, the various filter-beds, the 84 miles of distributing main pipes, as well as the various pipe yards, gate-houses, siphon and terminal chambers, and other structures connected with the several reservoirs and aqueducts, the dwellings for attendants, and various other buildings used or held for operating purposes. There are in addition the Mystic pumping station and the Mystic Aqueduct, which have not been in active operation during the past year.

## (2) STORAGE RESERVOIRS.

The various storage reservoirs of the Wachusett, Cochituate and Sudbury watersheds have normal capacities amounting to 80,823,000,000 gallons, though a somewhat larger amount of water than the stated capacity is at certain periods actually held by some of them. The various capacities are as follows:—

		Gallons.
Cochituate watershed:—		
Lake Cochituate, including Dudley Pond,	.	2,242,400,000
Sudbury watershed:—		
Sudbury Reservoir,	.	7,253,500,000
Framingham Reservoir No. 1,	.	287,500,000
Framingham Reservoir No. 2,	.	529,900,000
Framingham Reservoir No. 3,	.	1,180,000,000
Ashland Reservoir,	.	1,416,400,000
Hopkinton Reservoir,	.	1,520,900,000
Whitehall Reservoir,	.	1,256,900,000
Farm Pond,	.	167,500,000
Wachusett watershed:—		
Wachusett Reservoir,	.	64,968,000,000
Total,	.	80,823,000,000

The quantity of water contained in the storage reservoirs on January 1, 1907, was 44,153,200,000 gallons. This quantity was increased during the month of January by about 2,600,000,000 gallons, but subsequently, and until the middle of March, there was a loss in storage to an amount of about 2,000,000,000 gallons. From the latter date there was a constant gain until June 11, amounting to a total of about 9,600,000,000 gallons. Subsequent to the last date, and until September 23, there was a continual loss in the quantity of water stored, amounting in all to a quantity about 1,000,000,000 gallons less than the gain which had been effected. The great rainfalls which afterwards occurred and continued until the end of the year increased the quantity in storage by about 20,000,000,000 gallons, so that the entire amount contained in the various reservoirs on December 31, 1907, was 65,859,500,000 gallons,—the largest quantity ever held in storage.

There has been a large increase in the quantity of water in storage in the Wachusett Reservoir. At the beginning of the year the reservoir contained 31,752,900,000 gallons, and at the end of the year

the quantity was 51,267,000,000 gallons, — a gain in the year of 19,514,100,000 gallons. The elevation of the water at the beginning of the year was 364.57 feet above the Boston City Base, or 30.43 feet below the level of the reservoir if filled to high-water mark. The water rose gradually to an elevation of 372.97 feet, but in the summer there was a considerable lowering of the water. During the last three months of the year there was an almost continuous rise, amounting to 15.40 feet, and on December 31 it had risen to a height 10.69 feet below the high-water level.

Water was almost continuously drawn from the Wachusett Reservoir for the Metropolitan Water District, and it contributed the larger part of the entire supply. The only water otherwise discharged from the reservoir was that which was allowed to flow into the river below the dam in accordance with the requirements for the use of the Lancaster Mills. The quantity thus discharged was 3,884,000 gallons per day.

The marginal lands about the Wachusett Reservoir below the anticipated flow line have been kept mowed and in proper condition, and some repairs have been required where the shore had been washed by the heavier rains. Some changes have been made in the operation of the sluice gates and valves in the gate-chambers of the gate-houses by which the noise and vibration, which had formerly been a serious annoyance, has been almost entirely eliminated.

The water of the Sudbury Reservoir, into which is conveyed all of the supply coming through the Wachusett Aqueduct from the Wachusett Reservoir, was in the earlier months kept at a level a little below the stone crest of the dam, in order to provide storage for the yield of the Sudbury watershed. Later in the year, however, the water was allowed to reach Framingham Reservoir No. 3 by flowing over the crest of the Sudbury Dam. The water is supplied from the Sudbury Reservoir to the Metropolitan District through Framingham Reservoir No. 3, and thence by the Sudbury Aqueduct, and also through the Weston Aqueduct. Framingham Reservoir No. 3, from which the water is taken substantially during the entire year, was kept at a level a little below the crest of the overflow.

By an arrangement made with the Boston & Worcester Street Railway Company, under chapter 530, Acts of the year 1906, the company has been straightening and widening the roadways along



both Framingham Reservoir No. 3 and Framingham Reservoir No. 1. This work has necessitated a little filling of the reservoirs at the points of widening, by which the capacity of Reservoir No. 3 will be reduced by about 3,500,000 gallons. The work has been done by and at the expense of the railway company, but proper precautions have been enforced in order to prevent injury to the property of the Commonwealth and the pollution of the water. The company is also to compensate the Commonwealth for the loss of storage capacity.

Water was drawn from Framingham Reservoir No. 2 for the supply of the Metropolitan District for about five months in the middle of the year, and for a few days later in the season water was drawn from this reservoir to replenish Lake Cochituate. From Framingham Reservoir No. 1 water was drawn for short periods in the latter part of the year to replenish Lake Cochituate. Water was drawn for the supply of the Metropolitan District from the Ashland Reservoir for a period of a little more than two months late in the summer and early in the fall, causing a great decrease in the amount in storage, but this decrease was nearly made up during the latter part of the year. In like manner the Hopkinton Reservoir was drawn upon for the supply of the District, greatly reducing the amount in storage, but the reservoir had been nearly refilled at the end of the year. No water was taken during the year from Whitehall Reservoir. The water of this reservoir has, however, been kept near the high-water mark for use in case of necessity. It has been necessary to make some regulations in relation to boating upon this reservoir, for the purpose of enforcing sanitary regulations. No water has been drawn from Farm Pond during the year for the purpose of water supply.

By an arrangement originally made with the city of Boston, in the year 1885, the Framingham Water Company was permitted to take the waters of Farm Pond and Sudbury River to such an extent as might be needed for water supply for the town of Framingham, the water to be taken by the company directly from the pond or from the Sudbury Aqueduct, as the Boston Water Board should from time to time determine. It was, however, provided that the company should not be required to take the water from the pond during such time as the water should be unfit for domestic use. For this water a compensation was to be paid at certain rates, but

the contract was terminable by either party upon written notice to the other of one year. During the larger part of the time the water has been taken by the Framingham Water Company and by its successor, the town of Framingham, from the filter galleries built alongside the pond; but during a part of the past year the water of the pond has been deemed unfit for the purposes of a domestic supply, and the town of Framingham has taken a portion of its water supply directly from the aqueduct. Inasmuch as the rate of compensation in case the entire or a large part of the supply of the town is taken from the aqueduct is deemed by the Board inadequate, a notice has been given by the Board of its purpose to terminate the present contract, which will accordingly be terminated on February 1, 1908. Terms for a new contract have been under consideration, but no definite action has been taken.

The level of the water in Lake Cochituate was at the beginning of the year nearly 6 feet below high-water mark, but it gradually rose and the lake was kept nearly full from the middle of April until early in July. The lowest point was reached late in September, when it was about 7 feet below high-water mark. Water was drawn from the lake at different periods of the year, amounting to between seven and eight months.

The marginal line of ownership of the Commonwealth about Lake Cochituate is very irregular, and can be recognized only by the presence of the stone bounds. The original stone bounds set by the city of Boston were so small that many of them have been thrown out of position by the frost or pulled up and lost. In order that the location of the property line of the Commonwealth can be accurately determined, a considerable number of these bounds have been reset during the year and many new bounds have been erected. It is proposed to place further new bounds at necessary points during the coming year.

The widening of the road-bed of the Boston & Albany Railroad has necessitated the lengthening of the stone arch culvert, where the road passes over the Beaver Dam Brook arm of Lake Cochituate, and also some filling in the lake at points where the railroad runs alongside the shores. Careful sanitary inspection has been maintained in order to prevent the use of unsuitable materials in the work of filling, and also to prevent the possibility of the pollution of the lake or of its tributaries during the progress of the work.

## (3) DISTRIBUTING RESERVOIRS.

The distributing reservoirs, so called, situated within the Metropolitan District, are maintained not only for facilitating the distribution of water, but also to afford additional protection in case of emergencies. The capacities of these reservoirs are as follows: —

	Capacity in Gallons.
Spot Pond, . . . . .	1,791,700,000
Chestnut Hill Reservoir, . . . . .	300,000,000
Weston Reservoir, . . . . .	200,000,000
Fells Reservoir, . . . . .	41,400,000
Mystic Reservoir, . . . . .	26,200,000
Waban Hill Reservoir, . . . . .	13,500,000
Forbes Hill Reservoir, . . . . .	5,100,000
Bear Hill Reservoir, . . . . .	2,450,000
Arlington Standpipe, . . . . .	550,000
Forbes Hill Standpipe, . . . . .	330,000
Total, . . . . .	2,381,230,000

All of these reservoirs have been kept in good condition, and they have called for but little except the ordinary repairs and the work which has been required for the destruction of the gypsy and brown-tail moths. More than the usual care and policing are required, especially for the Chestnut Hill Reservoir, Mystic Reservoir, Spot Pond and Forbes Hill standpipe, on account of the large number of visitors who frequent the grounds, particularly on Sundays and holidays.

## (4) AQUEDUCTS.

The total amount of water carried through the different aqueducts to the Metropolitan District was a daily average of 126,403,000 gallons. There was drawn from the Wachusett Reservoir through the Wachusett Aqueduct into the Sudbury Reservoir an average of 82,589,000 gallons per day. An average of 84,655,000 gallons per day was carried from Framingham Reservoirs Nos. 2 and 3 through the Sudbury Aqueduct to the Chestnut Hill Reservoir, and an average of 11,398,000 gallons per day from Lake Cochituate through the Cochituate Aqueduct to the same reservoir. Through the Weston Aqueduct an average of 30,350,000 gallons per day was drawn from the Sudbury Reservoir into the distribution system of the

District. The Spot Pond watershed is estimated to have furnished in addition 418,000 gallons per day.

The Wachusett Aqueduct was in active operation on 333 days during the year. Considerable wire fencing has been erected along the line of the aqueduct, to prevent cattle from trespassing upon the embankments. Brush and weeds have been removed, and the fruit trees especially have been cut and carried away.

The Sudbury Aqueduct was in operation on 357 days of the year for conveying water to the Chestnut Hill Reservoir, and on 7 days water was conveyed through the aqueduct from Framingham reservoirs Nos. 1 and 2 to Lake Cochituate.

The Cochituate Aqueduct was in use 216 days of the year. The flow through the aqueduct was suspended for several weeks on account of the laying, by the city of Newton, of a pipe sewer and under-drain beneath the aqueduct. Considerable work was done along the line of the aqueduct in setting property bounds.

Water was drawn through the Weston Aqueduct for a period of 359 days. It was deemed necessary during the year to erect a barn on land of the Commonwealth along the aqueduct for the use of the foreman in charge of the line.

#### (5) PUMPING STATIONS.

The water which is supplied to the Metropolitan District is substantially all received from the Cochituate and Sudbury aqueducts at or near the Chestnut Hill Reservoir and thence pumped into the distribution system, or is conveyed through the Weston Aqueduct and distributed through the system by gravity. Seventy-five per cent. of the water thus supplied was received and pumped at the two stations at Chestnut Hill Reservoir. The water is pumped from the Chestnut Hill high-service station to the higher districts of Boston, and to Quincy, Watertown, Belmont and a part of Milton. From the Chestnut Hill low-service station the water is pumped to the lower districts of Boston, including Boston proper, South Boston and portions of Roxbury and Dorchester, to Somerville, Chelsea, Malden, Medford, Everett and Arlington, and also to Spot Pond. Water is pumped a second time from Spot Pond to Melrose, Revere, Winthrop, Nahant, Swampscott, and the higher portions of Somerville, Chelsea, Malden, Medford and Everett. From the Arlington pumping station the water is pumped a second time to Lexington and the

higher portions of Arlington, and from the West Roxbury station to the higher portions of West Roxbury and Milton.

The quantity of water pumped at all of these stations during the year was 38,213,520,000 gallons, which was an increase of 8.6 per cent. over the quantity pumped during the preceding year. The cost of operating all the stations during the year was \$112,-248.67, or \$2.937 per million gallons pumped, — a cost of \$0.027 per million gallons over the cost of the preceding year. There was a considerable increase in the cost of labor, owing in part to the decrease in the hours of labor of pumping station employés, and in part to the increase in the rates of wages paid to the employés. There was generally a slight decrease in the cost of fuel used at the stations, so that the result has been that the average cost at all the stations of raising one million gallons of water one foot high has been the same as during the preceding year, or \$0.0329.

During the year 12,126.87 tons of coal were purchased for use at the various stations. Of this total, 7,200.17 tons were bituminous, 350.53 tons anthracite, 3,961.58 tons buckwheat anthracite, and 614.59 tons were anthracite screenings. The average price per gross ton for the bituminous coal varied at the different stations from \$3.99 to \$4.84. The cost of the anthracite used was \$7.28 per gross ton, of the buckwheat anthracite \$2.87, \$2.97 and \$3.01, and of the anthracite screenings \$2.24.

Tests have been continued in order to determine the heating value of the coal used and offered for use in the several stations, and also to determine the viscosity, specific gravity and burning point of the oil used.

The cost per million gallons of water raised one foot was: for the Chestnut Hill high-service station, \$0.028; for the Chestnut Hill low-service station, \$0.031; for the Spot Pond station, \$0.034; for the Arlington station, \$0.127; for the West Roxbury station, \$0.210.

At the Chestnut Hill high-service station not only has a new boiler been installed, but the foundations of the old boilers have been renewed and considerable repairs have been required on another of the boilers. An accident occurred also to one of the smaller pumping engines, which made necessary a new cylinder and piston. These repairs increased somewhat the operating cost of the station.

By reason of the delay in the completion of the new Arlington pumping station and of the installation of the machinery, the old



engines in the temporary station were kept in service nearly the entire year, the first of the new engines having been put into regular service in the month of December. On account of the necessity of maintaining both the old and new stations for a considerable portion of the year, the cost of operation of this station has been larger than during the preceding year.

Owing to the discovery and stopping of leaks in the West Roxbury mains, the quantity of water pumped during the year at the West Roxbury station has been less than during the previous year. No extensive repairs have been called for at this station, but the pumps will soon reach their limit of safety, it being necessary now at times to operate both of them to their full capacity.

#### (6) PIPE LINES.

No break has occurred in the pipes during the past year. Thirty leaks have been found and repaired upon the pipe lines. All but three of these leaks occurred in joints of the pipes. Fourteen of them were found upon the pipe lines which cross the Charles and Mystic rivers, where the changes of temperature especially affect the pipes. The cost of repairing the leaks in the river pipes is considerable, as the employment of a diver and dredge is necessary.

A new Venturi meter has been placed in the force main leading from the new Arlington pumping station, and it has been necessary to enlarge the Venturi meter measuring the water supplied to the West Roxbury district, on account of the increased consumption. At several points it has been necessary to take measures to protect the registers from freezing. Valves have been continued in use for reducing and regulating the pressure of water supplied in the remoter districts. Considerable general repairs have been required during the year.

#### (7) SEWERAGE AND FILTRATION WORKS.

##### (a) *Clinton Sewerage Works.*

There was a large increase in the quantity of sewage received at the Clinton pumping station from the Clinton sewers, the total increase over the preceding year amounting to between 8 and 9 per cent. This increase was largely, however, due to the leakage of ground water into the sewers during the three months when the rainfall was unusually great, the daily average quantity of sewage re-



ceived during these months being double the amount received during the dry months of the year.

Experiments have been continued at the filter-beds under the direction of the Chief Engineer of the State Board of Health, and also further changes have been made in the practical treatment of the sewage, for the purpose of increasing the efficiency of the filtration. The 8 settling basins have been put into use during the greater part of the year for much shorter periods of time, and the filter-beds also, which number 25, are made to receive the sewage much more frequently and for a very short period at a time, so that each filter-bed has in general been in use a part of every day. The changes which have been made in the method of applying the sewage have thus far slightly improved the character of the effluent, and it is anticipated that a greater efficiency will be attained under the system which has been put into use and as a result of the experiments which are in progress.

The total cost of pumping was \$4,579.76, which is largely in excess of the cost of last year. This increase is due not only to the larger quantity of sewage pumped, but also to the necessity which came for unusually large repairs, and especially to the increase in the rate of wages in connection with the lessened number of hours of labor. The cost per million gallons pumped was \$4.47, and the cost per million gallons of sewage raised one foot was \$0.28. There was a corresponding but not so great an increase in the cost of maintenance of the filter-beds, which amounted to \$3,055.18, — a cost per million gallons treated of \$9.77.

The farmers in the neighborhood are becoming each year more desirous of obtaining the sludge removed from the settling basins, which is furnished them free for use on their farms.

#### *(b) Marlborough Filter-beds.*

The Marlborough filter-beds, built to filter the waters of a brook running through a part of the city of Marlborough which at times also receives the washings from the streets, have been sufficient for the proper filtration of all the waters without any direct discharge into the Sudbury Reservoir. There has been but little overflow during the year from the Marlborough sewers into the small filtration basin constructed to receive the sewage in case the city system should be inadequate to dispose of all the contents of the sewers.

*(c) Pegan Filtration Works.*

The Pegan Brook filter-beds, which are situated in Natick at Lake Cochituate, were in operation on 228 days during the year. A total quantity of 266,000,000 gallons was received from the Pegan Brook, and 98,859,000 gallons from the intercepting ditch which, built around the shores of Lake Cochituate, collects the water from the brooks which formerly entered into the Pegan Brook Meadow.

The cost of operating the pumping station and maintenance of the filter-beds, grounds and ditches was \$2,841.14, a cost per million gallons pumped of \$9.29. This was a material decrease in the cost of the operation of these works, owing to the fact that the thorough cleaning occasionally required was not done in the past year.

The widening of the road-bed of the Boston & Albany Railroad has decreased somewhat the capacity of one of the filter-beds.

*(8) SANITARY INSPECTION AND WORK.*

William W. Locke, C.E., has been in immediate charge of the sanitary inspection of all of the watersheds, and has been aided by two regular assistants and by such laborers and others as have been required from time to time.

No epidemic has occurred during the year on any of the watersheds. There were 6 sporadic cases of typhoid fever upon the Wachusett watershed, and 30 such cases upon the Sudbury and Cochituate watersheds, a total of 36 cases, as compared with 55 cases in the preceding year. In 18 of these cases the patients resided in houses connected with public sewers which discharge the sewage outside of the watershed, and none of the whole number of cases occurred upon lands belonging to the Commonwealth. In all the cases, however, proper precautions were at once taken to prevent a possible pollution of the water supply, and no ill effects have resulted so far as known.

Inspection during the year upon the Wachusett watershed was made of 1,461 private premises, for the purpose of ascertaining whether there were any conditions needing correction or improvement, particularly with reference to cesspools, privy and sink drainage, manure piles and manufacturing wastes. Of these, 1,323 were

declared to be satisfactory at the end of the year, and 138 cases were pronounced "unsatisfactory," this term including all cases where there may be under the most unfavorable conditions wash from privies or direct sink drainage, all suspected cases, and all cases of manufacturing wastes entering brooks or feeders to the reservoir notwithstanding such attempts as may have been made to purify them. Remedies for defects which were found were effected in 42 cases, 5 of which were remedied by the construction of filter-beds. Partial remedy was effected in 8 cases.

On the Sudbury and Cochituate watersheds 7,227 premises were inspected, and of these, 7,197 were pronounced satisfactory at the end of the year and 330 unsatisfactory. In 163 cases remedies were effected by sewer connections, and in other cases were otherwise remedied. Partial remedy was effected in 25 cases. Considerable attention has been devoted to preventing the pollution of the water supply by the different gangs of men employed in the building of State highways in Boylston, West Boylston and Holden, in the widening of the Boston & Worcester Street Railway in Framingham, in widening the road-bed of the Boston & Albany Railroad in Natick, and in laying of water pipes for the Westborough Insane Hospital in Crane Swamp in Westborough.

Water is collected at weekly intervals from the various storage and distributing reservoirs and as often as monthly from the various main feeders of the water system, and sent to the laboratory of the Board for examination microscopically and for color, odor, taste and turbidity. Samples of water are also collected at monthly and semi-monthly periods from different points upon the works, and sent to the State Board of Health for chemical analysis. In the biological laboratory of the Board 2,624 microscopical, 1,212 biological and 24 chemical examinations have been made. The bacteriological work consisted of examinations of the main feeders of the Sudbury Reservoir, of Framingham Reservoir No. 3 and of Lake Cochituate, and also testing the efficiency of the Pegan Brook, Marlborough Brook and Sterling filter-beds.

The sanitary condition of the Wachusett watershed has been much improved during the year by the construction of the Sterling filter-beds, and also by the construction of the small filter-beds near the Sterling Camp Grounds. There have also been destroyed 10 addi-

tional buildings upon property belonging to the Commonwealth, and the premises formerly occupied by these buildings, particularly the sites of the old Dorr and Warfield mills in Holden, and of the Gates farm buildings on Lake Waushacum, have been cleaned up and put in proper sanitary condition.

On the Cochituate and Sudbury watersheds railroad companies whose tracks cross the Framingham reservoirs have, at the request of the Board, caused tight floors to be laid over the bridges, for the purpose of preventing any direct pollution of the water from the passing trains.

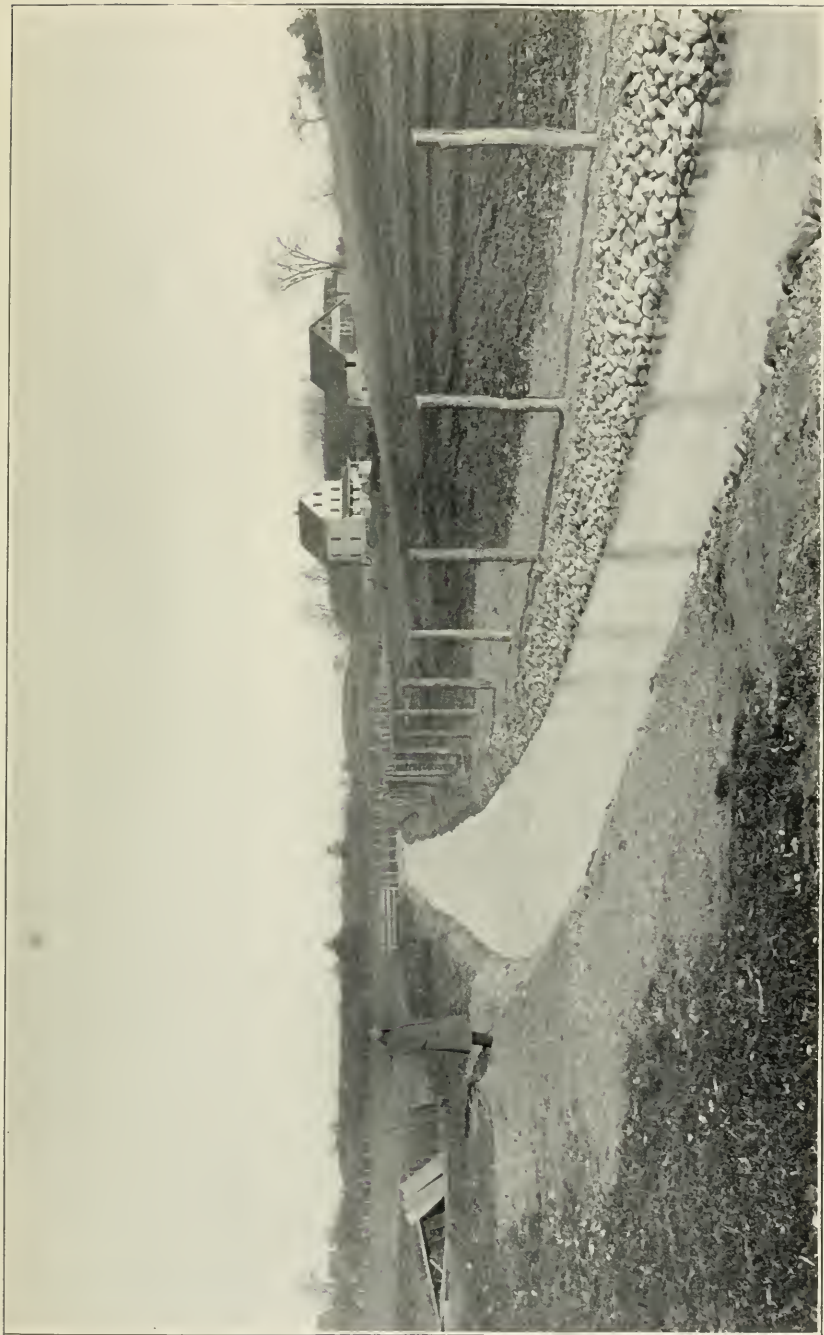
The drainage ditches which have been constructed in swamps on the different watersheds, aggregating a length of 31.66 miles, have been cleaned, and the weeds and brush on the sides have been mowed and burned. Some of the ditches on the Sudbury watershed have required repaving where the slopes have been trampled by cattle.

Snake Brook, which flows into Lake Cochituate, has been improved for a distance of about 1,900 feet by removing the weeds and shrubs and by the gravelling and paving of the bottom and sides, and for a considerable distance a new and more direct channel has been constructed. Portions of land which approached too closely the brook have been acquired, and considerable wire fencing has been done to protect the land belonging to the Commonwealth from the cattle in the abutting pastures.

Considerable improvement has also been effected in the condition of Beaver Dam Brook, which, running through portions of the towns of Framingham and Natick, is one of the principal feeders of Lake Cochituate. For about two miles before entering the lake the stream is sluggish, and large quantities of mud, as well as débris of all kinds, thrown or falling into the water, have collected in the various pools. Much of the objectionable matter has been removed, and the heavy growth of shrubbery bordering the brook has been largely cut and destroyed. A survey and examination of the lower part of the brook have also been made, with a view to more extensive improvement of the conditions in the future.

The Board has continued the policy of restricting and regulating boating and fishing upon Lake Cochituate, for the purpose of protecting the water of the lake from further pollution. No boating or fishing has been allowed upon the section of the lake lying north of Lake Avenue, from which the water is delivered directly into the Cochituate Aqueduct.





IMPROVEMENT OF SNAKE BROOK NEAR LAKE COCHITUATE.





Boating and fishing have been permitted in the remaining portions of the lake during the season beginning with April 1 and ending on October 15, in boats registered in accordance with the regulations which have been made and by persons who have been duly licensed by the Board. Permission has been given to the public to fish from the highway during the season named, and at other seasons to fish through the ice in other than the prohibited portion of the lake.

Applications for registration of boats were received to the number of 176, and 142 of these were granted, 3 of them with privilege of using tenders also for various sail and motor boats. Of those whose applications were granted, 114 were residents of Natick in the vicinity of the lake; 6 were residents of the village of Cochituate, the adjoining portion of the town of Wayland; and 22 were owners or lessees of cottages built upon land immediately abutting the shore margins. Of the 34 applications which were rejected, 10 were made subsequent to the time limited for filing the applications; 7 were from residents of towns not bordering upon the lake; 5 were from those who had become owners or lessees of cottages subsequent to March 1, 1906; 2 were from applicants who had in the previous year violated the regulations; 3 were in cases where registration had been already granted to members of the family; and 7 were for the use of tenders for which arrangements were otherwise made. No other registration was refused to residents of the territory immediately surrounding the lake or to those who had been owners or lessees of surrounding cottages prior to March 1, 1906.

Stringent measures were enforced for keeping the premises abutting the shore margins in good sanitary condition, and for preventing the pollution of the water by the cottagers and campers.

The owners and lessees of registered boats have shown a helpful cooperation with the Board by the satisfactory observance of the regulations which have been adopted for the protection of the water supply. No violation of the regulations was reported for prosecution.

An appeal which had been taken to the Supreme Court upon an injunction which had been granted against an owner of one of the cottages who had persisted in violating the rules of the Board was overruled by the full bench of the court.

## (9) FORESTRY.

The operations carried on in past years about the Wachusett Reservoir in the way of clearing the margin and replacing and planting the trees has been hitherto in part classed under construction. All the work is now done under the head of maintenance.

The clearing of a strip, along the extreme margin of the territory owned by the Commonwealth, through the wooded and shrub land, has been extended during the past year for a length of about 2 miles, so that now a cleared margin about 40 feet wide, called the fire guard, is around the entire limits of the Commonwealth's property. A strip about 15 feet wide has also been cleared on each side of brooks through wooded lands to the length of about 5,700 feet.

Mature and otherwise undesirable trees have been cut down in other places, and considerable areas have been improved by the thinning out of the trees. A large area which had been previously planted with white pines, upon which has come up a heavy growth of birches, alders and briers, has been cleared by the cutting out of the trees and brush which would interfere with the growth of the pines. The timber obtained by these processes has amounted to about 15,000 feet, board measure, and in addition more than 450 cords of firewood have been obtained. The most of the timber and firewood has been sold.

The greater part of the cleared margin of the reservoir had been previously planted, principally with arbor vitæ, and there remains about  $1\frac{1}{2}$  miles in length still to be treated. Inasmuch, however, as many of these trees had failed, it was determined to postpone the further planting until a stock of larger trees could be obtained from the nurseries. An area of about 20 acres has been planted with white pine seedlings, and the locusts upon the Oakdale flats, which had died, have been replaced. The total marginal land around the reservoir belonging to the Commonwealth is now estimated to comprise 3,412 acres. Of this aggregate, 1,483 acres were more or less wooded when acquired. There have been planted with trees 1,117 acres, and there are 315 acres which it is proposed to plant in the future. The marginal strip immediately along the shores of the reservoir contains 197 acres, and there are 300 acres which it is not proposed to plant with trees.

The Flagg and the Lamson nurseries, so called, situated respectively on the south and north sides of the reservoir, have been maintained. At the Flagg nursery a great number of white pines and arbor vitæ have been removed from the nursery beds to the transplant rows. The nursery now contains in the transplant rows 363,540 white pines, 28,300 arbor vitæ, 4,380 Scotch pines and 3,140 white spruces. Many arbor vitæ seedlings have also been transferred from this nursery to the Lamson nursery, where the soil is better adapted for their growth. The Lamson nursery contains in transplant rows 154,200 arbor vitæ, 13,580 sugar maples, 8,810 locusts, 3,090 white oaks, 3,000 ashes, 2,300 walnuts, 700 Norway spruces and 54 catalpas.

About the Sudbury Reservoir and around Framingham reservoirs Nos. 2 and 3 many worthless apple trees have been cut down, and, so far as marketable, sold for firewood; and a large quantity of brush has also been collected and burned. White pine trees to the number of 3,200 have been planted during the year at the Sudbury Reservoir.

#### (10) MOTH SUPPRESSION.

The extensive work which has been carried on by the Board in previous years on the lands under its charge, not only at Spot Pond but in the cities of Medford and Somerville and the town of Arlington, has resulted in greatly reducing the number of gypsy moths, and it is believed that the work of the past year will be felt by a still further reduction in their number in the future.

There has, however, during the year been a considerable increase in the number of gypsy moths along the lines of the Sudbury and Cochituate aqueducts in Newton, Weston, Natick and Framingham. The 220 acres of land about the Weston Reservoir and lying along the Weston Aqueduct between the reservoir and the terminal chamber were especially infested, and the cost of protecting these lands was more than double the amount expended in the previous year. No gypsy moths have been found upon the property of the Board situate west of the town of Framingham.

The number of brown-tail moths at the Chestnut Hill Reservoir and on other lands in the vicinity of Boston has been greatly decreased, apparently from natural causes. Very large numbers of nests of the brown-tail moths have been destroyed at the Sudbury Reservoir, and these nests in considerable and increasing numbers have been de-

stroyed at the Hopkinton Reservoir, along the line of the Wachusett Aqueduct in Southborough and Northborough, and in the vicinity of the Wachusett Reservoir in Clinton.

The methods employed for destroying and for preventing the spreading of the moths were similar to those of preceding years. The egg clusters of the gypsy moths were painted during the winter season with a mixture of creosote and fuel oil, in the spring tangle-foot was used in large quantities for banding the trees, and in the summer many trees were sprayed with arsenate of lead. In order to protect the lands of the Commonwealth along the lines of adjoining properties where moths were prevalent, lines of boards were set on edge and smeared with tanglefoot.

It has been found necessary, where there were thick growths of underbrush, particularly along the lines of the aqueducts, to cut away the underbrush and also the undesirable trees.

The total amount expended for the purpose on the Water Works lands was \$10,700, being \$2,000 less than the expenditure of the previous year. Of the total amount expended, \$6,450 was devoted to lands about Spot Pond and \$1,300 to those about the Weston Reservoir.

#### (11) QUALITY OF THE WATER.

The quality of the water supplied to the Metropolitan District has been good throughout the year, and has somewhat improved in quality over the preceding year. The color has remained substantially the same, but the microscopic organisms have decreased in number. Especial improvement has been observed in the quality of the water of the Wachusett Reservoir, as well as of the Sudbury Reservoir and Framingham Reservoir No. 3. There have been few growths of objectionable taste or odor. The number of organisms found in Lake Cochituate is larger than that in any other source of regular supply, and for about one-third of the year the number was such as to make the water objectionable for use, although not injurious to the public health. But little trouble has been experienced in the water coming from other sources.

#### (12) THE WATER SUPPLY.

For the fourth consecutive year the rainfall on the Sudbury and Wachusett watersheds and the amount of water yielded have both been below the average for the years during which records have been

kept. The rainfall during the past year on the Sudbury watershed was 44.38 inches, or 1.61 inches below the average. On the Wachusett watershed the total rainfall was 45.74 inches, or 3.25 inches below the average. On both of the watersheds the yield during the early part of the year was far below the average, and was the lowest or nearly the lowest recorded. During the last four months of the year, however, the rainfall and yield were unusually large, so that the yield for the entire year of both the Sudbury and Wachusett watersheds was but little below the average.

All the cities and towns constituting the Metropolitan Water District have been supplied with water, except the city of Newton and the town of Hyde Park, whose sources of supply are still adequate for their purposes. Water was furnished by special agreement to the town of Swampscott, which is without the limits of the District; and to a small part of the town of Saugus, which is directly supplied by special arrangement by the town of Revere; and 50,000 gallons daily were supplied to the United States Government reservation on Peddock's Island, in accordance with arrangements made with the Government.

The total quantity of water supplied by the Metropolitan Water Works to the various cities and towns, including the small quantity yielded by the Spot Pond watershed, as determined at the pumping stations and by the flow through the Weston Aqueduct, was 45,650,-960,000 gallons. The average quantity daily supplied was 125,071,-000 gallons, which is an increase in the daily supply of 6,251,000 gallons.

The increase in population of the territory supplied with water over that of last year is estimated at 19,690, the estimated population as of July 1, 1907, being 933,400.

The daily average quantity of water measured by the Venturi meters as delivered to the various municipalities is, owing to leakage from reservoirs and pipe lines, as well as in a small degree to the use of water at the pumping stations, 885,900 gallons less than the daily average amount above given.

The city of Newton and the town of Hyde Park supplied from their own sources to their respective inhabitants a total of 1,273,639,-347 gallons, being a daily average of 65.5 gallons per inhabitant.



## V. WATER WORKS — FINANCIAL STATEMENT.

By chapter 235 of the Acts of the year 1906, the Board was required on or before the third Wednesday in January of each year to report to the General Court an abstract of its receipts, expenditures, disbursements, assets and liabilities for the previous fiscal year (which, by the provisions of chapter 211 of the Acts of the year 1905, is the year beginning with the first day of December and ending with the thirtieth day of November), together with all recommendations for legislation which it should deem desirable; and the Board was also required by the Act of 1906 to present in the month of February a more detailed statement of its doings for the calendar year next preceding, which detailed statement should be printed as its annual report for the year.

The financial abstract for the fiscal year ending with the thirtieth day of November, 1907, was accordingly presented to the General Court in January, and a copy of this financial abstract is in part printed as Appendix No. 5.

The following statement of its financial doings, in relation to the Metropolitan Water Works, for the calendar year 1907, is herewith presented, in accordance with the provisions of the Act of 1906, as a part of the annual report of the Board.

The Metropolitan Water Loans authorized for the construction and acquisition of works have amounted to \$40,500,000. To this sum are added the proceeds from the sale of certain property by the Board, and these amounted on January 1, 1908, to \$158,408.11. The total amount, therefore, which the Board has been authorized to expend is \$40,658,408.11. The amount of expenditures approved by the Board for payment out of the Metropolitan Water Loan Fund was, for the year 1907, \$188,631.02, and the total amount so approved for payment since the beginning of the work up to January 1, 1908, has been \$40,467,508.04. There was accordingly a balance remaining at the beginning of the year 1908 amounting to \$190,900.07.

The Treasurer of the Commonwealth has issued from time to time, on the request of the Board, bonds to the amount of \$40,500,000. These bonds were issued for terms of 39½ and 40 years from the



date of issue, and bear interest at the rate of 3 per cent. and  $3\frac{1}{2}$  per cent. per annum. The sinking fund established for the payment of the bonds at maturity amounted on January 1, 1908, to \$5,643,575.69.

The amount approved by the Board for the maintenance and operation of the Water Works for the year 1907, which was paid out of the annual assessments, was \$373,334.07.

The assessments for the year 1907, for the payment of interest on the bonds, for the sinking fund requirements, and for the expenses of operation and maintenance of the Water Works, which were levied upon the various cities and towns in the Metropolitan District, amounted to \$2,195,406.71.

The detailed financial statement regarding the Metropolitan Water Works is as follows:—

#### (1) METROPOLITAN WATER LOANS, RECEIPTS AND PAYMENTS.

The loans for the construction and acquisition of the Metropolitan Water Works, the receipts which are added to the proceeds of these loans, the expenditures for the construction and acquisition of works, and the balance available on January 1, 1908, have been as follows:—

Loan under chapter 488 of the Acts of 1895, . . . . .	\$27,000,000 00
Loan under chapter 453 of the Acts of 1901, . . . . .	13,000,000 00
Loan under chapter 367 of the Acts of 1906, . . . . .	500 000 00
	<hr/>
	\$40,500,000 00
Proceeds from the sales of property applicable to the construction and acquisition of works (of which \$10,046.70 is for the year 1907), . . . . .	158,408 11
	<hr/>
	\$40,658,408 11
Amount approved by the Metropolitan Water and Sewerage Board for payments to December 31, 1907 (of which \$188,631.02 is for the year 1907), . . . . .	40,467,508 04
	<hr/>
Balance January 1, 1908, . . . . .	\$190,900 07

#### (2) ISSUES OF METROPOLITAN WATER LOAN BONDS.

The Treasurer of the Commonwealth, under the authority given him to issue from time to time, on the request of the Board, negotiable bonds to an amount not exceeding \$40,500,000, to be designated the "Metropolitan Water Loan," has sold bonds as follows:—

DATE OF SALE.	Amount of Bonds sold.	Rate of In- terest (Per Cent.).	Price received.	Date due.	Premium.
Sept. 25, 1895, . . . . .	\$5,000,000	3½	110.67	July 1, 1935,	\$533,500 00
Nov. 23, 1896, . . . . .	2,000,000	3½	106.76268	July 1, 1935,	135,253 60 <sup>1</sup>
Feb. 8, 1897, . . . . .	6,000,000	3½	107.82	July 1, 1935,	460,200 00
Jan. 13, 1898, . . . . .	2,000,000	3½	113.176	Jan. 1, 1938,	263,520 00
Mar. 2, 1898, . . . . .	2,000,000	3½	112.877	Jan. 1, 1938,	257,540 00
June 15, 1899, . . . . .	3,000,000	3	100.64	July 1, 1939,	19,200 00
June 28, 1900, . . . . .	1,000,000	3	102.78	July 1, 1939,	27,800 00
Mar. 5, 1901, . . . . .	3,000,000	3	102.155	Jan. 1, 1941,	64,650 00
July 24, 1901, . . . . .	100,000	3	100.375	Jan. 1, 1941,	375 00
July 24, 1901, . . . . .	150,000	3	100.10	Jan. 1, 1941,	150 00
July 30, 1901, . . . . .	205,000	3	100.25	Jan. 1, 1941,	512 50
July 31, 1901, . . . . .	50,000	3	100.25	Jan. 1, 1941,	125 00
Aug. 7, 1901, . . . . .	50,000	3	100.50	Jan. 1, 1941,	250 00
Aug. 8, 1901, . . . . .	300,000	3	100.10	Jan. 1, 1941,	300 00
Aug. 8, 1901, . . . . .	200,000	3	100.25	Jan. 1, 1941,	500 00
Sept. 17, 1901, . . . . .	3,100,000	3½	106.71	Jan. 1, 1941,	208,010 00
Oct. 1, 1901, . . . . .	1,345,000	3	100.	Jan. 1, 1941,	-
Oct. 24, 1901, . . . . .	1,500,000	3	100.	Jan. 1, 1941,	-
Feb. 26, 1902, . . . . .	500,000	3½	109.13	Jan. 1, 1942,	45,650 00
Feb. 26, 1902, . . . . .	3,000,000	3½	109.13	Jan. 1, 1942,	273,900 00
April 7, 1903, . . . . .	250,000	3½	106.725	Jan. 1, 1943,	16,812 50
April 17, 1903, . . . . .	1,250,000	3½	106.1329	Jan. 1, 1943,	76,661 25
Jan. 15, 1904, . . . . .	500,000	3½	104.60	Jan. 1, 1943,	23,000 00
Jan. 15, 1904, . . . . .	2,000,000	3½	104.60	Jan. 1, 1944,	92,000 00
Mar. 24, 1905, . . . . .	650,000	3½	105.761	Jan. 1, 1945,	37,446 50
June 28, 1906, . . . . .	943,000	3½	103.09	Jan. 1, 1946,	29,138 70
June 28, 1906, . . . . .	100,000	3½	103.09 <sup>2</sup>	Jan. 1, 1946,	3,090 00
June 28, 1906, . . . . .	307,000	3½	103.09 <sup>2</sup>	Jan. 1, 1946,	9,486 30
	\$40,500,000				\$2,588,071 35

<sup>1</sup> Including \$18,673.60 from readjustment of rate made by the Treasurer in 1897.

<sup>2</sup> Not issued or delivered until 1907.

### (3) METROPOLITAN WATER LOAN SINKING FUND.

The sinking fund established by the Treasurer of the Commonwealth has amounted at the end of each year to sums as follows: —

December 31, 1895, . . . . .	\$226,286 05
December 31, 1896, . . . . .	699,860 70
December 31, 1897, . . . . .	954,469 00
December 31, 1898, . . . . .	1,416,374 29
December 31, 1899, . . . . .	1,349,332 97
December 31, 1900, . . . . .	1,573,619 72
December 31, 1901, . . . . .	1,662,426 95
December 31, 1902, . . . . .	2,256,803 81
December 31, 1903, . . . . .	2,877,835 59
December 31, 1904, . . . . .	3,519,602 92
December 31, 1905, . . . . .	4 207,045 69
December 31, 1906, . . . . .	4,897,822 62
December 31, 1907, . . . . .	5,643,575 69

### (4) ANNUAL ASSESSMENTS AND RECEIPTS.

Assessments for the year, amounting to \$2,195,406.71, were required for the payment of the interest on the bonds issued by the Commonwealth, the sinking fund requirements, and the expenses of

operation and maintenance of the Water Works. The requirements were: for interest; \$1,281,908.77; for the sinking fund, \$523,-697.26; and for maintenance and operation, \$389,800.68. These assessments were made by the Treasurer of the Commonwealth upon the various municipalities as follows:—

Arlington, . . . .	\$14,738 41	Nahant, . . . .	\$4,204 56
Belmont, . . . .	6,026 81	Newton, . . . .	6,026 82
Boston, . . . .	1,726,588 68	Quincy, . . . .	50,027 14
Chelsea, . . . .	58,058 80	Revere, . . . .	19,633 70
Everett, . . . .	41,044 26	Somerville, . . . .	106,334 61
Hyde Park, . . . .	1,194 73	Stoneham, . . . .	7,734 91
Lexington, . . . .	6,987 53	Watertown, . . . .	15,468 18
Malden, . . . .	40,082 71	Winthrop, . . . .	14,624 69
Medford, . . . .	35,126 98		
Melrose, . . . .	26,971 19		
Milton, . . . .	14,532 00		
			<hr/>
			\$2,195,406 71

The comparatively smaller sums assessed upon the city of Newton and the town of Hyde Park were owing to the fact that neither of these municipalities had reached the safe capacity of its own sources of water supply, and neither had been furnished with water.

The proceeds from the operations of the Board, exclusive of the proceeds from sales of property and of water, are, in accordance with the provisions of the Statutes, applied to the reduction of the assessment, and these, for the year 1907, amounted to \$7,148.55.

The actual expenditures for the maintenance and operation of the Metropolitan Water Works were, for the year 1907, \$373,334.07.

#### (5) SUPPLYING WATER TO CITIES AND TOWNS OUTSIDE OF DISTRICT AND TO WATER COMPANIES.

Sums have been received during the year 1907, under the provisions of the Metropolitan Water Act, for water furnished, as follows:—

Town of Framingham, . . . .	\$147 67
Town of Swampscott, . . . .	4,800 00
Framingham Water Company, . . . .	666 35
United States Government, . . . .	1,321 40
	<hr/>
	\$6,935 42

## (6) EXPENDITURES FOR THE DIFFERENT WORKS.

The following is a summary of the expenditures made in the various operations for the different works:—

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
Administration applicable to all parts of the construction and acquisition of the works, . . . .	\$6,366 96	\$268,968 42
Wachusett Dam and Reservoir:—		
Wachusett Dam, . . . . .	\$14,982 35	\$2,285,099 20
Power plant, . . . . .	118 00	118 00
North Dike, . . . . .	40,659 32	790,470 68
South Dike, . . . . .	186 00	137,057 10
Removal of soil, . . . . .	8,059 22	2,536,214 37
Relocation of railroads, . . . . .	1,026 51	878,022 45
Roads and bridges, . . . . .	2,036 07	547,180 33
Real estate, . . . . .	16,890 16	3,195,950 73
Damages, real estate not taken, business and loss of wages, . . . . .	14,102 22	518,743 74
Other expenses, . . . . .	1,532 50	8,272 92
	99,592 35	10,897,129 52
Improving Wachusett watershed, . . . . .	19,370 72	207,406 53
Wachusett Aqueduct, . . . . .	252 05	1,797,946 85
Sudbury Reservoir, . . . . .	—	2,922,445 21
Protection of Sudbury supply, . . . . .	—	129,190 36
Improving Sudbury watershed, . . . . .	99 45	95,484 54
Protection of Cochituate supply, . . . . .	—	9,000 00
Improving Cochituate watershed, . . . . .	—	8,860 68
Improving Lake Cochituate, . . . . .	—	103,537 29
Pipe lines, Dam No. 3 to Dam No. 1, . . . . .	—	48,471 48
Pipe line, Rosemary siphon, . . . . .	—	23,142 98
Weston Aqueduct:—		
Aqueduct, . . . . .	\$48 34	\$2,352,184 66
Reservoir, . . . . .	153 70	288,838 06
Supply pipe lines, . . . . .	—	584,635 71
Real estate, taxes and other expenses, . . . . .	3,157 09	207,643 12
	3,359 13	3,433,305 55
Distribution system:—		
Low service:—		
Pipe lines and connections, . . . . .	\$1,247 02	\$1,752,873 08
Pumping station, Chestnut Hill, . . . . .	—	462,572 19
Reservoir, Spot Pond, . . . . .	4,087 15	582,188 73
Gate house and connections, Chestnut Hill Reservoir, . . . . .	—	65,480 88
Real estate and other expenses, . . . . .	811 40	91,722 06
Northern high service:—		
Pipe lines and connections, . . . . .	1 50	440,540 78
Spot Pond pumping station, . . . . .	—	291,829 35
Fells Reservoir, Stoneham, . . . . .	—	141,392 94
Bear Hill Reservoir, Stoneham, . . . . .	—	38,267 70
Real estate and other expenses, . . . . .	—	14,838 05
Amounts carried forward, . . . . .	\$6,147 07	\$3,881,705 76
	\$120,040 66	\$19,944,889 41

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1907.		From Beginning of Work to December 31, 1907.	
<i>Amounts brought forward,</i> . . .	\$6,147 07	\$129,040 66	\$3,881,705 76	\$19,944,889 41
Distribution system — <i>Concluded.</i>				
Southern high service: —				
Pipe lines and connections, . . .	234 75		515,132 30	
Pumping station, Chestnut Hill, . .	4,703 44		246,928 96	
Forbes Hill Reservoir, Quincy, . .	—		90,003 49	
Waban Hill Reservoir, Newton, . .	—		61,592 11	
Real estate and other expenses, . .	—		10,226 36	
Northern extra high service, . . .	42,785 27		72,029 13	
Southern extra high service, . . .	—		22,830 67	
Meters and connections, . . . . .	73 42		77,038 33	
Improving Spot Pond Brook, . . . .	—		3,991 23	
Glenwood pipe yard, . . . . .	—		33,100 59	
Chestnut Hill pipe yard, . . . . .	—		11,311 26	
Diversion of water, South Branch of Nashua River, <sup>1</sup> . . . . .		53,943 95		5,025,890 19
Acquisition of existing water works: —		3,391 30		1,363,631 76
Reimbursement city of Boston, partially constructed Sudbury Reservoir, . . .	—		\$1,157,921 59	
To Boston, for works taken January 1, 1898, . . . . .	—		12,768,948 80	
To Malden, Medford and Melrose for taking of Spot Pond, . . . . .	—		1,240,229 62	
To Newton, for Waban Hill Reservoir, .	—		60,000 00	
Transfers of works acquired and other property to accounts for special works, .	—		\$15,227,100 01	
			1,240,262 50	
			\$13,986,837 51	
Engineering, conveyancing, etc., . . .	—		73,126 22	14,059,963 73
<i>Pipes, Valves, Castings, etc., sent first to Storage Yards, and afterwards transferred as needed to Different Parts of the Work.</i>				
Sent to storage yards, . . . . .	\$4,021 36		\$2,092,396 06	
Transferred from storage yards to works, and included in costs above, . . . .	1,766 25		2,019,263 11	
		2,255 11		73,132 95
Total for constructing and acquiring of works, . . . . .		\$188,631 02		\$40,467,508 04

<sup>1</sup> Of the total expenditures from the beginning of the work, the sum of \$150,928.29 is for Clinton sewerage system.

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1907.	
Administration, . . . . .	. . .	\$12,018 78
General supervision, . . . . .	. . .	5,795 05
Taxes and other expenses, . . . . .	. . .	35,198 61
Wachusett Reservoir Department:—		
General superintendence, . . . . .	\$5,101 81	
Superintendence, . . . . .	262 20	
Reservoir, . . . . .	24,036 07	
Forestry, . . . . .	7,141 45	
Protection of supply, . . . . .	3,398 32	
Buildings and grounds, . . . . .	2,453 30	
Wachusett dam, . . . . .	6,176 34	
Wachusett aqueduct, . . . . .	3,939 48	
Clinton sewerage system:—		
Pumping station, . . . . .	4,450 95	
Sewers, screens and filter-beds, . . . . .	3,552 03	
Sanitary inspection, . . . . .	2,532 91	
Swamp drainage, . . . . .	897 23	
		63,951 99
Sudbury Department:—		
General superintendence, . . . . .	\$3,414 04	
Superintendence, Framingham office, . . . . .	7,172 67	
Ashland Reservoir, . . . . .	1,768 05	
Hopkinton Reservoir, . . . . .	2,052 00	
Whitehall Reservoir, . . . . .	349 50	
Framingham Reservoirs, 1, 2 and 3, . . . . .	6,293 98	
Sudbury Reservoir, . . . . .	5,760 95	
Lake Cochituate, . . . . .	5,588 86	
Marlborough Brook filters, . . . . .	1,763 38	
Pegan filters, . . . . .	2,741 03	
Sudbury and Cochituate watersheds, . . . . .	3,711 00	
Sanitary inspection, . . . . .	3,143 05	
Cochituate Aqueduct, . . . . .	8,001 57	
Sudbury Aqueduct, . . . . .	6,776 69	
Weston Aqueduct, . . . . .	5,784 42	
Biological laboratory, . . . . .	2,805 64	
		67,126 83
Distribution Department:—		
General superintendence, . . . . .	\$10,144 28	
Superintendence, . . . . .	316 44	
Arlington Pumping station, pumping service, . . . . .	8,285 22	
Chestnut Hill low-service pumping station, pumping service, . . . . .	34,070 16	
Chestnut Hill high-service pumping station, pumping service, . . . . .	46,084 00	
Spot Pond pumping station, pumping service, . . . . .	14,265 07	
West Roxbury pumping station, pumping service, . . . . .	7,028 93	
Arlington standpipe, . . . . .	36 81	
Bear Hill Reservoir, . . . . .	178 94	
Chestnut Hill Reservoir, . . . . .	13,423 51	
Fells Reservoir, . . . . .	421 85	
Forbes Hill Reservoir, . . . . .	1,364 62	
Mystic Lake, conduit and pumping station, . . . . .	1,984 62	
Mystic Reservoir, . . . . .	1,485 16	
<i>Amounts carried forward, . . . . .</i>	\$139,089 61	\$184,091 26



MAINTENANCE AND OPERATION.	For the Year ending December 31, 1907.	
<i>Amounts brought forward,</i> . . . . .	\$139,089 61	\$184,091 26
<i>Distribution Department—Concluded.</i>		
Waban Hill Reservoir, . . . . .	773 85	
Weston Reservoir, . . . . .	2,608 13	
Spot Pond, . . . . .	9,974 11	
Buildings at Spot Pond, . . . . .	545 83	
Spot Pond Brook, . . . . .	305 34	
Pipe lines:—		
Low service, . . . . .	10,012 48	
Northern high service, . . . . .	2,935 95	
Southern high service, . . . . .	4,203 86	
Supply pipe lines, . . . . .	576 50	
Buildings at Chestnut Hill, . . . . .	2,474 88	
Chestnut Hill pipe yard, . . . . .	779 37	
Glenwood pipe yard and buildings, . . . . .	4,973 04	
Stables, . . . . .	5,945 94	
Waste prevention, . . . . .	66 35	
Venturi meters, . . . . .	1,835 64	
Measurement of water, . . . . .	2,141 33	
		189,242 81
Total for maintaining and operating works, . . . . .		\$373,334 07

### (7) DETAILED FINANCIAL STATEMENT UNDER METROPOLITAN WATER ACT.

The Board herewith presents, in accordance with the requirements of the Metropolitan Water Act, a detailed statement of the expenditures and disbursements, receipts, assets and liabilities for the year 1907.

#### (a) *Expenditures and Disbursements.*

The total amount of the expenditures and disbursements on account of construction and acquisition of works for the year beginning January 1, 1907, and ending December 31, 1907, is \$188,631.02, and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1907, is \$40,467,508.04.

For maintenance and operation the expenditures for the year have been \$373,334.07, and from the beginning of the work, \$3,024,296.31.

The salaries of the commissioners, and other expenses of administration, have been apportioned to the construction of the works and to the maintenance and operation of the same, and appear under each of those headings.

The following is a division of the expenditures according to their general character:—

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
<b>CONSTRUCTION OF WORKS AND ACQUISITION BY PURCHASE OR TAKING.</b>		
<i>Administration.</i>		
Commissioners, . . . . .	\$2,333 33	\$112,643 58
Secretary and auditor, . . . . .	1,125 00	48,342 03
Clerks and stenographers, . . . . .	1,876 67	57,449 16
Legal services, . . . . .	-	2,359 00
Travelling, . . . . .	15 41	3,640 89
Stationery and printing, . . . . .	427 92	11,195 76
Postage, express and telegrams, . . . . .	53 10	2,807 17
Furniture and fixtures, . . . . .	-	4,280 89
Alterations and repairs of buildings, . . . . .	32 00	5,784 27
Telephone, lighting, heating, water and care of building, . . . . .	230 75	11,130 84
Rent and taxes, main office, . . . . .	239 80	4,857 01
Miscellaneous expenses, . . . . .	32 98	4,477 82
	\$6,366 96	\$268,968 42
<i>Engineering.</i>		
Chief engineer and department engineers, . . . . .	\$655 80	\$207,171 36
Principal assistant engineers, . . . . .	3,996 28	155,003 89
Engineering assistants, . . . . .	16,307 15	1,023,465 97
Consulting engineers, . . . . .	30 00	23,500 07
Inspectors, . . . . .	95 00	290,217 39
Architects, . . . . .	-	36,161 19
Railroad and street car travel, . . . . .	25 42	26,804 91
Wagon hire, . . . . .	220 30	45,028 78
Stationery and printing, . . . . .	125 02	25,995 77
Postage, express and telegrams, . . . . .	19 92	7,723 83
Engineering and drafting instruments and tools, . . . . .	23 25	19,308 03
Engineering and drafting supplies, . . . . .	154 35	24,961 71
Books, maps and photographic supplies, . . . . .	130 38	6,931 72
Furniture and fixtures, . . . . .	1 00	14,978 46
Alterations and repairs of buildings:—		
Main office, . . . . .	69 00	14,107 86
Sub-offices, . . . . .	-	2,939 36
Telephone, lighting, heating, water and care of buildings:—		
Main office, . . . . .	675 66	24,076 81
Sub-offices, . . . . .	175 96	19,622 32
Rent and taxes, main office, . . . . .	719 42	14,339 45
Rent of sub-offices and other buildings, . . . . .	-	4,526 74
Field offices and sheds, . . . . .	-	1,274 49
Clinton office building, . . . . .	-	9,866 87
Unclassified supplies, . . . . .	-	8,240 53
Miscellaneous expenses, . . . . .	300 13	8,924 32
	23,724 04	2,015,861 83
<i>Amounts carried forward,</i> . . . . .	\$30,091 00	\$2,284,830 25

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
<i>Amounts brought forward,</i> . . . .	\$30,091 00	\$2,284,830 25
<i>Construction.</i>		
Preliminary work (borings, test pits and other investigations):—		
Advertising, . . . . .	-	\$6,306 22
Other preliminary work as given in detail in preceding annual report, . . . .	-	155,457 41
		161,763 63
Contracts, Wachusett Reservoir:—		
Contracts completed and final payments made prior to January 1, 1907, . . .	-	\$3,418,405 03
McBride & Co., Stillwater improvement, Sundry bills paid under this contract, .	\$17 15	23,314 67
McArthur Bros. Co., Wachusett Dam, . .	625 31	3,476 60
McArthur Bros. Co., item 26 in suit pend- ing in Superior Court, . . . . .	1,606,481 04	3,331 23
McArthur Bros. Co., building Sect. 2 of the relocation of Central Massachusetts Railroad, . . . . .	3,331 23	286,521 00
	311 61	5,341,529 57
Contracts improving Wachusett Water- shed:—	4,285 30	
A. McKenzie & Co., Sterling filter-beds, .	3,403 66	11,893 75
Contracts completed, Wachusett Aqueduct,	-	1,447,208 55
Contracts completed, Sudbury Reservoir, .	-	1,545,028 33
Contracts completed, protection Sudbury Supply:—		
City of Marlborough, main sewer, . . .	-	9,000 00
Contracts completed, improving Lake Co- chituate, . . . . .	-	60,657 45
Contracts completed, protection Cochituate Supply:—		
Town of Framingham, low-level sewer, .	-	9,000 00
Contracts completed, Rosemary siphon, .	-	5,916 96
Contracts completed, pipe line, Dam No. 3 to Dam No. 1, . . . . .	-	17,240 22
Contracts completed, Clinton sewerage sys- tem, . . . . .	-	66,878 22
Contracts, Weston Aqueduct:—		
Contracts completed and final payments made prior to January 1, 1907, . . .	-	\$1,781,564 31
Shanahan, Casparis & Co., . Sect. 2,	-	201,827 74
Sundry bills paid under this contract .	-	2,911 80
Shanahan, Casparis & Co., . Sect. 3,	-	126,420 70
Sundry bills paid under this contract, .	-	4,214 78
Shanahan, Casparis & Co., . Sect. 6,	-	108,933 26
Sundry bills paid under this contract, .	-	7,013 05
Shanahan, Casparis & Co, . Sect. 12,	-	138,151 78
Sundry bills paid under this contract, .	-	3,339 77
		2,374,377 19
<i>Amounts carried forward,</i> . . . .	\$87,779 96	\$13,335,324 12

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
<i>Amounts brought forward,</i> . . . .	\$87,779 96	\$13,335,324 12
<i>Construction — Con.</i>		
Contracts, Distribution System: —		
Contracts completed and final payments made prior to January 1, 1907, . . . .	-	\$4,387,773 91
C. A. Dodge & Co., Arlington pumping station, . . . . .	\$18,307 77	29,498 21
Hodge Boiler Works Co., horizontal re- turn tubular boilers, . . . . .	6,694 00	6,694 00
Allis-Chalmers Co., pumping engine, . .	4,437 00	4,437 00
	29,438 77	\$4,428,403 12
Deduct value of pipes, valves, etc., included in above list, transferred to mainte- nance account December 31, 1900.	-	3,139 77
		4,425,263 35
<i>Additional work: —</i>		
Labor, . . . . .	\$61,406 88	\$752,186 89
Professional services, medical services, analyses, etc., . . . . .	38 98	1,857 99
Travelling, . . . . .	211 18	2,744 00
Rent, . . . . .	55 00	3,611 73
Water rates, . . . . .	-	1,454 77
Freight and express, . . . . .	293 52	12,944 51
Jobbing and repairing, . . . . .	48 93	9,668 08
Tools, machinery, appliances, and hard- ware supplies, . . . . .	830 67	73,942 77
Electrical supplies, . . . . .	-	4,924 68
Castings, ironwork and metals, . . . .	5,848 47	79,413 71
Iron pipe and valves, . . . . .	2,449 08	60,367 69
Blasting supplies, . . . . .	572 80	1,935 68
Paint and coating, . . . . .	1 75	4,316 43
Fuel, oil and waste, . . . . .	48 66	10,512 77
Lumber and field buildings, . . . . .	1,045 50	85,287 92
Drain pipe, . . . . .	63 06	9,150 37
Brick, cement and stone, . . . . .	1,227 37	26,388 79
Sand, gravel and filling, . . . . .	37 25	6,895 06
Municipal and corporation work, . . . .	721 23	208,887 90
Police service, . . . . .	-	210,801 74
Sanitary inspection, . . . . .	90 00	13,100 09
Judgments and settlements for damages,	5,860 40	52,624 26
Unclassified supplies, . . . . .	998 06	17,105 35
Miscellaneous expenses, . . . . .	1,486 01	5,929 10
	83,334 80	1,656,052 28
<i>Legal and expert: —</i>		
Legal services, . . . . .	-	\$4,668 82
Expert services, . . . . .	-	1,862 66
Court expenses, . . . . .	-	1,167 20
Miscellaneous expenses, . . . . .	\$14 75	185 80
	14 75	7,884 48
<i>Amounts carried forward,</i> . . . . .	\$150,568 28	\$19,424,524 23

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
<i>Amounts brought forward, . . . . .</i>	\$150,568 28	\$19,424,524 23
<i>Real Estate.</i>		
Legal and expert:—		
Legal services, . . . . .	—	\$4,736 31
Conveyancer and assistants, . . . . .	\$2,139 00	109,311 97
Experts, . . . . .	—	17,871 58
Appraisers, . . . . .	175 00	22,332 75
Court expenses, . . . . .	809 00	11,139 43
Counsel expenses, . . . . .	—	43 25
Conveyancing supplies, . . . . .	4 50	3,165 53
Conveyancing expenses, . . . . .	57 29	5,909 89
Miscellaneous expenses, . . . . .	—	4,195 81
Settlements made by Board, . . . . .	8,589 00	3,371,187 84
Judgments, . . . . .	2,240 49	168,682 24
Taxes and tax equivalents, . . . . .	—	68,182 41
Care and disposal, . . . . .	3,987 44	84,740 09
	18,001 72	3,871,499 10
<i>Damages to Real Estate not taken, to Business and on Account of Loss of Wages.</i>		
Legal and expert:—		
Legal services, . . . . .	—	\$1,130 67
Expert services, . . . . .	\$1,222 54	2,857 62
Court expenses, . . . . .	1,662 55	14,157 84
Settlements, . . . . .	12,885 00	414,330 32
Judgments, . . . . .	1,217 22	104,413 42
	16,987 31	536,889 87
<i>Claims on Account of Diversion of Water.</i>		
Legal and expert:—		
Legal services, . . . . .	—	\$3,774 98
Expert services, . . . . .	—	19,339 69
Court expenses, . . . . .	\$703 00	20,775 49
Miscellaneous expenses, . . . . .	9 95	1,289 58
Settlements, . . . . .	—	917,350 00
Judgments, . . . . .	2,360 76	220,719 67
	3,073 71	1,183,249 41
<i>Purchase of Existing Water Works.</i>		
Legal and expert:—		
Legal services, . . . . .	—	\$1,878 89
Expert services, . . . . .	—	13,569 82
Court expenses, . . . . .	—	29,728 38
Miscellaneous expenses, . . . . .	—	1,470 94
Settlements and judgments, . . . . .	—	15,227,100 01
		15,273,748 04
<i>Relocation Central Massachusetts Railroad.</i>		
Settlements, . . . . .	—	177,597 39
Total amount of construction expenditures, . . . . .	\$188,631 02	\$40,467,508 04

GENERAL CHARACTER OF EXPENDITURES.		For the Year ending December 31, 1907.
MAINTENANCE AND OPERATION OF WORKS.		
Administration:—		
Commissioners, . . . . .	\$3,500	00
Secretary and assistants, . . . . .	4,628	51
Postage, printing, stationery and other supplies, . . . . .	974	38
Travelling, . . . . .	1,725	19
Telephone, heating, lighting and care of building, . . . . .	574	46
Alterations and repairs of building, . . . . .	190	93
Rent and taxes, office building, . . . . .	359	70
Miscellaneous expenses, . . . . .	65	61
		\$12,018 78
Supervision and general superintendence:—		
Chief engineer and department engineers, . . . . .	\$6,323	45
Engineering, clerical and laboratory assistants, . . . . .	10,160	47
Postage, printing, stationery, office and laboratory supplies, . . . . .	1,595	26
Telephone, heating, lighting and care of offices, . . . . .	2,751	94
Travelling and incidental expenses, . . . . .	1,865	39
Alterations and repairs of buildings, . . . . .	280	80
Rent and taxes, main office, . . . . .	1,079	13
Miscellaneous expenses, . . . . .	398	74
		24,455 18
Pumping service:—		
Labor, . . . . .	\$59,910	95
Fuel, . . . . .	42,733	85
Oil, waste and packing, . . . . .	1,248	07
Repairs and renewals, . . . . .	3,180	09
Small supplies and expenses, . . . . .	1,887	02
Rent, West Roxbury pumping station, . . . . .	773	40
		109,733 38
Superintendents and assistant superintendents, . . . . .	\$4,522	72
Engineering assistants, . . . . .	9,871	74
Laboratory force, . . . . .	2,258	67
Sanitary inspectors, . . . . .	3,903	78
Recording and scientific instruments and supplies, . . . . .	242	80
Labor and teaming, . . . . .	124,124	89
Tools, machinery and appliances, . . . . .	3,287	79
Lumber and hardware supplies, . . . . .	4,440	70
Jobbing and repairing, . . . . .	1,127	46
Travelling, . . . . .	2,107	88
Horses, vehicles and stable expenses, . . . . .	6,506	83
Fuel, lighting and telephone, . . . . .	4,042	65
Municipal and corporation work, . . . . .	1,129	95
Unclassified supplies, . . . . .	5,099	77
Miscellaneous expenses, . . . . .	7,773	06
Conveyancer and assistants, . . . . .	121	00
Taxes and tax equivalents, . . . . .	35,027	61
Contracts and agreements, . . . . .	10,507	00
Contracts for pipes, valves, etc., bought from construction work since January 1, 1907, . . . . .	1,030	43
		227,126 73
Total expenditures for maintenance and operation, . . . . .		\$373,334 07



*(b) Receipts.*

The total amount of receipts from rents, sales of property, etc., for the year beginning January 1, 1907, and ending December 31, 1907, is \$24,130.67; and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1907, is \$524,436.88. The general character of these receipts is as follows:—

GENERAL CHARACTER OF RECEIPTS.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
For distribution back to District:—		
District entrance fees, . . . . .	-	\$92,265 00
Supplying water outside of District, . . . . .	-	60,454 77 <sup>1</sup>
Water furnished to water companies, . . . . .	-	37,145 88
		\$219,865 65
To the credit of the loan fund:—		
Real estate and buildings, . . . . .	\$720 00	\$34,361 46
Labor, tools, supplies and reimbursements, . . . . .	9,335 70	124,046 65
	\$10,046 70	158,408 11
To the credit of the sinking fund:—		
Supplying water to cities and towns outside of District and to water companies, . . . . .	\$6,935 42	\$7,156 43 <sup>1</sup>
Forfeiture for contracts awarded but not executed, . . . . .	-	500 00
Rents, . . . . .	1,696 38	90,021 99
Land products, . . . . .	5,108 16	45,602 11
Unclassified receipts and interest, . . . . .	344 01	2,882 59
	14,083 97	146,163 12
Total receipts, . . . . .	\$24,130 67	\$524,436 88

<sup>1</sup> \$221.01 received in December, 1906, was placed in sinking fund by State Treasurer in 1907. See chapter 238, Acts of 1907.

The foregoing receipts have been credited to the various objects or works, as follows:—

SOURCES OF RECEIPTS.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
Admission into Metropolitan Water District (Quincy, Nahant, Arlington, Stoneham, Milton and Lexington), . . . . .	-	\$92,265 00
Supplying water to cities and towns outside of Water District (Swampscott, Revere, Lexington, Wakefield, Cambridge, Framingham and U. S. Government), and to water companies (Framingham, Milton and Revere), . . . . .	\$6,935 42	134,757 08
	\$6,935 42	\$227,022 08
Amounts carried forward, . . . . .	\$6,935 42	\$227,022 08

SOURCES OF RECEIPTS.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
<i>Amounts brought forward,</i> . . . .	\$6,935 42	\$227,022 08
Construction and acquisition of works:—		
Administration, . . . . .	\$67 96	\$110 11
Wachusett Dam, . . . . .	1,059 60	6,684 48
Wachusett Reservoir, . . . . .	980 50	134,113 78
Wachusett Aqueduct, . . . . .	—	5,204 70
Weston Aqueduct, . . . . .	149 50	5,012 63
Sudbury Reservoir and watershed, . .	—	7,735 42
Distribution system, . . . . .	6,542 70	71,581 85
Diversion of water, Clinton sewerage system, . . . . .	90 00	1,367 94
Purchase of existing water works, . .	215 90	17,569 53
	9,106 16	249,380 44
Maintenance and operation of works:—		
Wachusett Aqueduct, . . . . .	\$365 94	\$4,116 81
Wachusett Reservoir, . . . . .	4,531 69	19,053 83
Sudbury system, . . . . .	1,802 08	11,812 97
Distribution system, . . . . .	649 54	9,120 47
Clinton sewerage system, . . . . .	739 84	3,930 28
	8,089 09	48,034 36
Total receipts, . . . . .	\$24,130 67	\$524,436 88

(c) *Assets.*

The following is an abstract of the assets of the Water Works, a complete schedule of which is kept on file in the office of the Board:—

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; police supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; real estate connected with works not completed; completed works, including real estate and buildings connected therewith.

(d) *Liabilities.*

There are liabilities as follows:—

Due on monthly pay rolls, . . . . . \$1,625 30

There are other current bills unpaid which have not yet been received.

Amounts have been agreed upon in the following cases, but the deeds have not yet passed: Henry B. Stone, \$12,500; town of West Boylston, \$800.

On the claims of the following it is impossible to state the amounts due for land damages, water rights and claims for damages to estab-

lished business, as no sums have been agreed upon, and suits are now pending in court for the determination of most of them:—

Charles C. Landy, Houghton Bros., Robert Johnston, John F. O'Brien, Patrick Bradley, Thomas H. Burgess, Lucy A. Wood, Joseph O. Bullard *et al.*, Elwin I. Chase, Alzina A. Wilson, Henry F. Keyes, Robert C. Houghton *et al.*, James E. Welch, Bridget M. Joyce, Byron D. Allen, J. Frank Wood *et al.*, Asa Knight, Mary J. Fyfe, estate of William E. Fyfe, George M. Plummer, Edward F. Merriam, James A. Bigelow, William H. Brigham, John Fitzgerald, estate of Charles H. Hastings, George R. Hastings, William H. Hastings, Henry J. Hyde, Everett and Oliver S. Kendall, Sanford C. Kendall, estate of John A. Wood, estate of William H. Vickery, James H. and Hannah S. Wood, Asenath M. Bartlett, estate of Charles I. Longley, estate of Daniel M. Marsh, Francis W. M. Goodale, McArthur Bros. Co., Sarah Hourty, Clara L. Kingsbury, George W. Shattuck, Samuel F. Mason, Nellie M. Kirby, Willis A. Fuller.

#### VI. METROPOLITAN SEWERAGE WORKS.

No changes in territory have been made in the districts contributing to the North Metropolitan System and the South Metropolitan System which comprise the Metropolitan Sewerage Works.

The North Metropolitan System provides for the district situated largely in the Charles River and Mystic River valleys lying north of the Charles River, and embraces the cities of Cambridge, Chelsea, Everett, Malden, Medford, Melrose, Somerville, Woburn and parts of Boston, and the towns of Arlington, Belmont, Revere, Stoneham, Wakefield, Winchester, Winthrop and part of Lexington,—9 cities and 8 towns. The district has an area of 90.50 square miles. It has an estimated population, as of December 31, 1907, based upon the census of 1905, of 498,640; and it is estimated that of this number 422,065, or 84.6 per cent., contribute sewage to the North Metropolitan System.

The South Metropolitan System provides for the areas situated in the Charles River valley lying south of the Charles River, a small portion of the valley north of the Charles River, and also a portion of the Neponset River valley; and embraces the cities of Newton, Quincy and Waltham, portions of the city of Boston, and the towns of Brookline, Hyde Park, Milton, Watertown and parts of Dedham,—4 cities and 5 towns. This district has an area of 100.87 square

miles. It has an estimated population, as of December 31, 1907, of 325,090, of which number it is estimated that 188,150, or 57.9 per cent., contribute sewage to the South Metropolitan System.

(1) NORTH METROPOLITAN SEWERAGE SYSTEM — CONSTRUCTION.

(a) *Malden Extension Sewer.*

The extension of the North Metropolitan System, authorized by chapter 319 of the Acts of the Legislature of the year 1906, from a point near the centre of the city of Malden to an outlet into the waters of the Malden River, was finally completed at the beginning of the year, and sewage was received into the sewer on January 5, 1907. The necessary resurfacing and paving of streets and other work required in private lands along the line of the sewer were made during the spring, but the sewer has been maintained as a part of the North Metropolitan System continuously since it was first put into operation. The sewer has an entire length of 2,950.5 feet, and is built with a diameter varying from about 2.5 feet to 4.5 feet. The total expenditures for the construction of this sewer have amounted to \$53,879.45, and there is a small amount still payable. The sum paid includes damages on account of the taking of real estate, which have thus far aggregated the sum of \$4,150.

(b) *Construction of Bulkhead and Filling of Chelsea Street Flats.*

The establishment by the United States Government of a pier-head line along Chelsea Creek has enabled the Board to fill in a considerable additional portion of the lot belonging to the Commonwealth on the northwesterly side of Chelsea Street which has been occupied for locker and stable buildings. A timber bulkhead has been constructed upon the lines laid down, and a considerable portion of the area enclosed has been filled. By this work the available area of the lot has been increased from about 10,000 square feet to an area of about 38,600 square feet. This work has so far been accomplished by the expenditure of \$3,231, and the value of the lot has been greatly enhanced.

(2) SOUTH METROPOLITAN SEWERAGE SYSTEM — CONSTRUCTION.

(a) *Extension of the High-level Sewer.*

The work of the extension of the High-level Sewer in accordance with the requirements of chapter 406 of the Acts of the year 1906,







SEWER CONSTRUCTION IN TRENCH ON COLUMBIA STREET, BROOKLINE—HIGH LEVEL SEWER EXTENSION.



from the main line of the sewer in Centre Street in Jamaica Plain through parts of West Roxbury, Brookline and Brighton, has been in progress during the year.

The construction of the first section in West Roxbury (near Jamaica Pond), which presented peculiar difficulties, on account of the presence of quicksand, gravel and clay, had been begun by day labor under the direct supervision of the engineers of the Board. This section is wholly in tunnel, and passes Jamaica Pond at a depth of 35 feet below the ordinary surface of the pond. It is constructed under the pneumatic process by the introduction of compressed air. The work has thus far been successfully prosecuted, and it is expected that this section will be completed by day labor in the coming summer.

Another portion of the sewer, which consisted in the building of a tunnel through Commonwealth Avenue and Warren Street in the Brighton district, largely in rock excavation, was constructed by the Board by day labor, because the bids for the construction of this part of the sewer had been so greatly in excess of the estimates of cost made by the engineer. This portion of the work has also been successfully completed under the immediate direction of the Board within the engineer's estimates.

Contracts have been made during the year for the construction of all the remaining portions of the sewer from its junction with the main line as far as Oak Square in Brighton, except for a short section near Oak Square about 2,450 feet in length.

Several of these contracts were made in the middle of the summer, and have been substantially completed. The terms of the other contracts which were made towards the end of the season require their completion during the year 1908.

A length of 2.24 miles of the 5.64 miles of sewer, upon which construction has been entered, has been completed. The construction on the High-level Sewer extension during the year has called for the expenditure of \$445,059.17.

#### *(b) Quincy Pumping Station.*

The new centrifugal pump purchased from the Lawrence Machine Company, having a capacity of pumping 10,000,000 gallons per 24 hours, was in the early part of the year fully installed in connection with the compound vertical engine, both engine and pump being of a

standard type. Two additional boilers of about 100 horse-power each were supplied. The whole additional plant has been in operation since March 1, 1907.

### (3) ACQUISITION OF LANDS AND SETTLEMENTS FOR LANDS ACQUIRED.

During the year there have been made 5 takings of land and easements, all in Brookline, for the purposes of the extension of the High-level Sewer. These takings embrace 0.362 of an acre in fee, and easements in 12.30 acres, most of which were in public streets.

The following is a list of the takings:—

#### *List of Takings for Metropolitan Sewerage Works for the Year 1907.*

No.	LOCATION AND DESCRIPTION.	Former Owners.	Recorded.	Purpose of Taking.
16	Brookline,—Park Street from Beacon Street to Washington Street. Area, easements in 1.68 acres.	Public street.	<b>1907.</b> Mar. 12.	Part of Section 82, South Metropolitan System.
17	Brookline,—from the end of a strip in which easements have been taken for the Metropolitan Sewer at the Boston line, through Columbia Street, land of Henry S. Coolidge <i>et al.</i> , Winchester Street and Beacon Street, to Park Street at the end of strip in which easements were taken by Taking No. 16. Area, fee in 0.362 acre, easements in 3.73 acres.	Henry S., Walter G. and Ellen G. Coolidge and public streets.	Mar. 28.	Section 83 and part of Section 84, South Metropolitan System.
18	Brookline,—from the end of a strip in which sewer easements were taken in Park Street by Taking No. 16, through Washington Street, Greenough Street and Gorham Avenue to a point near Davis Avenue. Area, easements in 1.83 acres.	Public streets.	May 20.	Part of Section 82, South Metropolitan System.
19	Brookline,—from the end of a strip in which sewer easements were taken in Gorham Avenue, through Davis Avenue, land of the town of Brookline, Tappan Street, land of Brookline, of the Boston & Albany Railroad Company and of George A. Goddard, Brington Road, Cypress Street and Kendall Street to Franklin Street. Area, easements in 3.08 acres.	Town of Brookline, Boston & Albany Railroad and George A. Goddard. Public streets.	July 5.	Parts of Sections 81 and 82, South Metropolitan System.
20	Brookline,—from a strip in which sewer easements were taken in Kendall Street by Taking No. 19, through Kendall Street and Chestnut Street to the Boston line, at the end of a strip in which sewer easements were taken by Taking No. 13. Area, easements in 1.98 acres.	Public streets.	Nov. 8.	Part of Section 81, South Metropolitan System.

Since January 1, 1907, settlements on account of the takings made in the North Metropolitan District have been effected in 2 cases, in-

volving a payment of \$2,150; and in 1 case in the South Metropolitan District a settlement has been effected, under which payment has been made amounting to \$5,582.20.

Of the 3 sewerage settlements, 2 were on account of the sewer extension to Malden and 1 on account of the extension of the High-level Sewer in Brookline.

*Summary of Land Settlements for the Year 1907.*

LOCATION.	Area in Acres.	Number of Settlements.	Payments.
<i>North Metropolitan District.</i>			
Malden, . . . . .	0.056	2	\$2,150 00
<i>South Metropolitan District.</i>			
Brookline, . . . . .	0.362	1	5,582 20
Aggregate, . . . . .	0.418	3	\$7,732 20

(4) NORTH METROPOLITAN SYSTEM — MAINTENANCE.

There are now maintained in the North Metropolitan System 58.57 miles of main sewers, with which are connected 624.74 miles of local sewers, the number of connections, public and special, with the North Metropolitan System being 638.

The East Boston and Charlestown districts of Boston and the cities of Everett, Cambridge, Somerville and Chelsea still maintain both separate and combined sewers, but all of the other municipalities in the North Metropolitan System maintain separate sewers.

There have been pumped at the Alewife Brook pumping station 4,123,000 gallons of sewage per day, with an average lift of 12.90 feet, at a cost of \$0.344 per million gallons per foot lifted; at the Charlestown station 32,600,000 gallons per day, 8.31 feet lift, at a cost of \$0.168 per million gallons per foot lifted; at the East Boston station 62,300,000 gallons per day, 16.74 feet lift, at a cost of \$0.081 per million gallons per foot lifted; and at the Deer Island station 64,300,000 gallons per day, 10.79 feet lift, at a cost of \$0.097 per million gallons lifted. There has continued to be a decided increase in the amount of sewage pumped in all of the stations, but the increase has particularly occurred in the East Boston and Deer Island stations, where the excess has been upwards of 6,000,000 gallons daily over

the quantities of last year. The increase in the amount of sewage at East Boston has exceeded by 11 per cent. and that at the Deer Island station has exceeded by more than 10.5 per cent. the quantities discharged last year. There has been a grèater cost of pumping, on account of the increased cost of labor and also the increased cost of coal.

The amount of sewage discharged in the North Metropolitan District averaged 152 gallons per day for each person, taking the estimated population of the district contributing sewage. If the sewers in this district were restricted to the admission of sewage proper only, and all local sewers were separate sewers, this per capita amount would be considerably decreased.

During the year 5 public and 13 special connections from local sewers have been made with the system, and 30.86 miles of local sewers have been added to those already connected with its works.

The extension of the main sewer, which receives the sewage of the town of Wakefield, from a point near the centre of the city of Malden to tide water, was completed at the beginning of the year, and has since been in continuous operation.

The cost of maintenance of the North Metropolitan System during the past year was \$138,271.99, which is somewhat more than the cost of maintenance for the preceding year.

#### (5) SOUTH METROPOLITAN SYSTEM — MAINTENANCE.

In the South Metropolitan System there are maintained 40.25 miles of main sewers, with which are connected 479.51 miles of local sewers, having 111 connections with the Metropolitan System.

The Back Bay, Roxbury, West Roxbury, Brighton and Dorchester districts of Boston and the towns of Brookline and Milton still maintain both separate and combined sewers, but all the other districts contributory to this system maintain separate sewers.

The Ward Street pumping station, the Quincy pumping station and the screen-house at Nut Island are maintained for the disposal of sewage for this system.

There have been pumped at the Ward Street station an average of 23,500,000 gallons per day, with an average lift of 41.57 feet, at a cost of \$0.074 per million gallons per foot lifted; and at the Quincy station 3,615,000 gallons, 21.04 feet lift, at an average cost of \$0.254 per million gallons per foot lifted.

An average of 40,600,000 gallons of sewage has passed daily through the screens at the Nut Island screen-house, and has been discharged from the outfalls into the outer harbor. The maximum discharge per day, which occurred during a heavy storm, was 137,000,000 gallons. The discharge of sewage through the outfalls represents the amount of sewage contributed in the South Metropolitan System, which was at the rate of 215 gallons per day per person of the estimated number contributing sewage in the District. The daily discharge of sewage per capita is considerably larger in the South Metropolitan District than it is in the North Metropolitan District, because, owing to the large size of the High-level Sewer, more storm water is admitted at periods of heavy rainfall.

The additional pumping engine which has been obtained for the Quiney station has been in operation since March 1, and has been successful in relieving the station from the troubles which had occurred, particularly in periods of unusual rainfall.

A small area in the districts of Dorchester and town of Milton, which is so low that its sewage cannot be carried into the High-level Sewer except by pumping, still disposes of its sewage through the Boston Main Drainage Works, and for this a rental is paid to the city of Boston. Otherwise, all the sewage of the South Metropolitan Sewerage District is disposed of through the outfall pipes from Nut Island.

The expenditures for maintenance of the South Metropolitan System for the past year were \$95,513.11.

#### VII. SEWERAGE WORKS — FINANCIAL STATEMENT.

The financial abstract of the receipts, expenditures, disbursements, assets and liabilities of the Metropolitan Water and Sewerage Board for the fiscal year of the Commonwealth ending with the thirtieth day of November, 1907, was, as stated in connection with the Water Works, presented to the General Court in January, in accordance with the requirements of chapter 235 of the Acts of the year 1906, and a copy of this financial abstract is in part printed as Appendix No. 5.

The following statement of its financial doings, in relation to the Metropolitan Sewerage Works, for the calendar year 1907, is herewith presented, in accordance with the provisions of the Act of 1906, as a part of the annual report of the Board.



The Metropolitan sewerage loans for the construction of the Sewerage Works of the North Metropolitan System have amounted to \$6,160,865.73, to which are added receipts from various sources amounting to \$17,153.40. The amount of expenditures approved by the Board for payment for the year 1907 was \$9,822.86, and the total amount of expenditures approved to January 1, 1908, was \$6,146,023.16. The balance on hand on January 1, 1908, was \$31,995.97.

The loans for the construction of the various parts of the South Metropolitan System have amounted to \$8,867,046.27. The receipts applicable to the loan fund have been \$10,106.60. The amount of expenditures approved for payment in the year 1907 was \$459,807.64. The total amount of expenditures approved for payment from the beginning of the works has been \$8,182,580.79. The balance on hand for the South Metropolitan System on January 1, 1908, was \$694,572.08.

The bonds issued on account of the loans have been for varying periods, not exceeding forty years, and bear interest at the rate of 3 per cent. and  $3\frac{1}{2}$  per cent. The premiums received on account of the sale of bonds on the North Metropolitan System have amounted to \$175,518.65, and those received on account of the South Metropolitan System have amounted to \$400,332.03.

The amount expended for maintenance of the North Metropolitan System in the year 1907 was \$138,271.99, and for the South Metropolitan System \$95,513.11, a total for both systems of \$233,785.10.

The assessments made to meet interest, sinking fund requirements, and maintenance and operation of the North Metropolitan System amounted in the year 1907 to \$270,448.12, and the assessments for the South Metropolitan System amounted to \$503,860.49.

The following is a detailed financial statement regarding the Metropolitan Sewerage Works:—

#### (1) METROPOLITAN SEWERAGE LOANS, RECEIPTS AND PAYMENTS.

The loans for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of these loans, and the expenditures for construction, have been as follows:—



*(a) North Metropolitan System.*

Loans under various acts of the Legislature (given in detail in report for the year 1901), . . . . .	\$5,605,865 73
Loans under chapters 242, 336 and 399, Acts of 1903, . . . . .	500,000 00
Loan under chapter 319, Acts of 1906, . . . . .	55,000 00
Proceeds from sales of property and from other sources to December 31, 1907, . . . . .	17,153 40
	<hr/>
	\$6,178,019 13
Amount approved by the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board for payment to December 31, 1907 (of which \$9,822.86 is for the year 1907), . .	6,146,023 16
	<hr/>
Balance, North Metropolitan System, January 1, 1908, . . .	\$31,995 97

*(b) South Metropolitan System.*

Loans under the Acts of the years 1889 and 1900 (Charles River Valley Sewer), . . . . .	\$800,046 27
Loans under various acts of the Legislature (given in detail in report for the year 1901, Neponset River Valley Sewer), . . .	900,000 00
Loan under chapter 315 of the Acts of 1903 (Neponset River Valley Sewer), . . . . .	4,000 00
Loan under chapter 424 of the Acts of 1899, . . . . .	4,600,000 00
Loan under chapter 356 of the Acts of 1903, . . . . .	996,000 00
Loans under chapters 230 and 246 of the Acts of 1904, . . . .	392,000 00
Loan under chapter 406 of the Acts of 1906, . . . . .	1,175,000 00
Proceeds from sales of property and other sources to December 31, 1907 (of which \$3,228.13 is for the year 1907), . . . .	10,106 60
	<hr/>
	\$8,877,152 87
Amount approved by the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board for payment to December 31, 1907 (of which \$459,807.64 is for the year 1907), .	8,182,580 79
	<hr/>
Balance, South Metropolitan System, January 1, 1908, . . .	\$694,572 08

*(2) ISSUES OF METROPOLITAN SEWERAGE LOAN BONDS.*

The Treasurer of the Commonwealth, under the authority of the successive statutes, has from time to time issued bonds designated "Metropolitan Sewerage Loan," as follows:—

## METROPOLITAN SEWER LOANS, NORTH SYSTEM.

*Bonds issued.*

DATE OF SALE.	Amount of Bonds sold.	Rate of In- terest (Per Cent.).	Price received.	Date due.	Premium.
Apr. 2, 1890, . . . . .	\$500,000	3	102.40	Jan. 1, 1930,	\$12,000 00
Apr. 2, 1890, . . . . .	500,000	3	103.02	Jan. 1, 1930,	15,100 00
Apr. 2, 1890, . . . . .	500,000	3	103.62	Jan. 1, 1930,	18,100 00
Apr. 2, 1890, . . . . .	500,000	3	102.327	Jan. 1, 1930,	11,635 00
Apr., 1890, . . . . .	200,000	3	103.	Jan. 1, 1930,	6,000 00
Feb., 1891, . . . . .	50,000	3	104.	Jan. 1, 1930,	} 35,130 30 <sup>1</sup>
Mar., 1891, . . . . .	300,000	3	104.	Jan. 1, 1930,	
Mar., 1891, . . . . .	18,000	3	104.	Jan. 1, 1930,	
Jan., 1892, . . . . .	35,000	3	100.	Jan. 1, 1930,	-
Feb., 1892, . . . . .	29,000	3	100.	Jan. 1, 1930,	-
Mar., 1892, . . . . .	50,000	3	101.	Jan. 1, 1930,	500 00
June, 1892, . . . . .	436,000	3	101.50	Jan. 1, 1930,	} 11,060 00 <sup>1</sup>
July, 1892, . . . . .	150,000	3	101.50	Jan. 1, 1930,	
Aug., 1892, . . . . .	150,000	3	101.50	Jan. 1, 1930,	
Nov., 1892, . . . . .	3,000	3	100.50	Jan. 1, 1930,	15 00
Nov., 1892, . . . . .	200,000	3	100.	Jan. 1, 1930,	-
Jan., 1893, . . . . .	35,000	3	100.50	Jan. 1, 1930,	175 00
Jan., 1893, . . . . .	25,000	3	100.50	Jan. 1, 1930,	125 00
Feb., 1893, . . . . .	20,000	3	101.	Jan. 1, 1930,	200 00
Feb., 1893, . . . . .	5,000	3	100.50	Jan. 1, 1930,	25 00
Feb., 1893, . . . . .	400,000	3	100.25	Jan. 1, 1930,	1,000 00
Mar., 1893, . . . . .	94,000	3	100.25	Jan. 1, 1930,	235 00
May 1, 1894, . . . . .	464,000	3	100.	Jan. 1, 1930,	-
Oct., 1894, . . . . .	4,000	3	100.	Jan. 1, 1930,	-
Oct., 1894, . . . . .	1,000	3	100.	Jan. 1, 1930,	-
Nov., 1894, . . . . .	15,000	3	100.	Jan. 1, 1930,	-
Nov., 1894, . . . . .	10,000	3	100.	Jan. 1, 1930,	-
Dec., 1894, . . . . .	6,000	3	100.	Jan. 1, 1930,	-
Apr., 1895, . . . . .	300,000	3	100.	Jan. 1, 1930,	-
Dec., 1896, . . . . .	30,000	3	100.	Jan. 1, 1930,	-
June, 1897, . . . . .	70,000	3½	106.243	Jan. 1, 1930,	} 5,084 80 <sup>1</sup>
June, 1897, . . . . .	10,000	3½	106.243	Jan. 1, 1930,	
Apr., 1898, . . . . .	5,000	3	100.	Jan. 1, 1930,	} 22,843 75 <sup>1</sup>
June, 1898, . . . . .	155,000	3½	100.	Jan. 1, 1930,	
June, 1898, . . . . .	60,000	3½	100.	Jan. 1, 1930,	
Apr., 1900, . . . . .	265,000	3	103.948	Jan. 1, 1930,	10,462 20
May, 1903, . . . . .	200,000	3½	104.9797	Jan. 1, 1930,	9,959 40
May, 1903, . . . . .	50,000	3½	106.2424	Jan. 1, 1943,	3,121 20
July, 1903, . . . . .	250,000	3½	104.419	July 1, 1943,	11,047 50
June, 1906, . . . . .	55,000	3½	103.09	July 1, 1943,	1,699 50
	\$6,150,000				\$175,518 65

<sup>1</sup> Readjustment of Treasurer.

## METROPOLITAN SEWER LOANS, SOUTH SYSTEM.

*Bonds issued.*

DATE OF SALE.	Amount of Bonds sold.	Rate of In- terest (Per Cent.).	Price received.	Date due.	Premium.
Apr., 1890, . . . . .	\$100,000	3	103.	Jan. 1, 1930,	\$3,000 00
Apr., 1890, . . . . .	400,000	3	103.	Jan. 1, 1930,	12,000 00
May, 1890, . . . . .	300,000	3	104.	Jan. 1, 1930,	12,000 00
Aug., 1895, . . . . .	300,000	3	100.585	Mar. 1, 1935,	1,755 00
Feb., 1896, . . . . .	50,000	3	100.	Mar. 1, 1935,	-
Dec., 1896, . . . . .	135,000	3	100.	Mar. 1, 1935,	-
Dec., 1896, . . . . .	15,000	3	100.	Mar. 1, 1935,	-
June, 1897, . . . . .	300,000	3½	106.98	Mar. 1, 1935,	20,940 00
June, 1898, . . . . .	35,000	3½	100.	Mar. 1, 1935,	4,088 00 <sup>1</sup>
June, 1899, . . . . .	25,000	3	100.64	Mar. 1, 1936,	160 00
June, 1899, . . . . .	1,000,000	3	100.64	July 1, 1939,	6,400 00
Sept., 1900, . . . . .	10,000	3	100.79	July 1, 1939,	79 00
Sept., 1900, . . . . .	912	3	100.	July 1, 1939,	-
Apr., 1901, . . . . .	40,000	3	100.915	Mar. 1, 1936,	366 00
Sept., 1901, . . . . .	2,000,000	3½	106.71	July 1, 1940,	134,200 00
Sept., 1902, . . . . .	14,000	3	100.	July 1, 1939,	-
Sept., 1902, . . . . .	500,000	3½	107.243	July 1, 1940,	36,215 00
Sept., 1902, . . . . .	150,000	3½	107.2395	July 1, 1940,	10,859 25
Dec., 1902, . . . . .	200,000	3½	107.79	July 1, 1940,	15,580 00
Feb., 1903, . . . . .	100,000	3½	108.25	July 1, 1940,	8,230 56 <sup>1</sup>
Apr., 1903, . . . . .	100,000	3½	106.75	July 1, 1940,	6,750 00
Apr., 1903, . . . . .	175,000	3½	106.75	July 1, 1940,	11,812 50
Apr., 1903, . . . . .	203,000	3½	106.75	July 1, 1940,	13,702 50
Apr., 1903, . . . . .	25,000	3½	106.494	July 1, 1940,	1,623 50
Apr., 1903, . . . . .	133,000	3½	105.9364	July 1, 1940,	7,895 42
May, 1903, . . . . .	996,000	3½	106.2424	Jan. 1, 1943,	62,174 31
May, 1903, . . . . .	4,000	3½	105.5453	Mar. 1, 1935,	221 81
July, 1904, . . . . .	392,000	3½	104.929	July 1, 1944,	19,321 68
June, 1906, . . . . .	154,000	3½	103.09	Jan. 1, 1946,	4,758 60
June, 1906, . . . . .	21,000	3½	103.09 <sup>2</sup>	Jan. 1, 1946,	648 90
Apr., 1907, . . . . .	300,000	3½	101.85	Jan. 1, 1947,	5,550 00
	\$8,177,912				\$400,332 03

<sup>1</sup> Readjustment of Treasurer.<sup>2</sup> Not issued or delivered until 1907.

## (3) METROPOLITAN SEWERAGE LOANS SINKING FUND.

Under authority of chapter 122 of the Acts of 1899, and section 14 of chapter 424 of the Acts of 1899, the Treasurer of the Commonwealth was required to consolidate the sinking funds of all the Metropolitan sewerage loans into one fund, to be known as the Metropolitan Sewerage Loans Sinking Fund. The Board received, during the year, from rentals and from other sources, to be applied to the sinking fund, \$109.21.

The sinking fund established has amounted at the end of each year to sums as follows: —

December 31, 1899,	. \$361,416 59	December 31, 1904,	. \$878,557 12
December 31, 1900,	. 454,520 57	December 31, 1905,	. 1,008,724 95
December 31, 1901,	. 545,668 26	December 31, 1906,	. 1,146,998 68
December 31, 1902,	. 636,084 04	December 31, 1907,	. 1,306,850 30
December 31, 1903,	. 754,690 41		

#### (4) ANNUAL APPROPRIATIONS, RECEIPTS AND EXPENDITURES.

The annual appropriations for the maintenance of the Metropolitan Sewerage Works, the receipts of the Board which are added to the appropriations for maintenance, and the expenditures for maintenance for the year ending December 31, 1907, have been as follows: —

##### *North Metropolitan System.*

Appropriations under chapter 201 of the Acts of 1907,	. . . \$143,000 00
Receipts from pumping and from other sources,	. . . 1,225 04
	<hr/>
	\$144,225 04
Amount approved by the Board for payment,	. . . 138,271 99
	<hr/>
Balance January 1, 1908,	. . . \$5,953 05

##### *South Metropolitan System.*

Appropriation under chapter 200 of the Acts of 1907,	. . . \$100,500 00
Receipts from pumping and from other sources,	. . . 23 25
	<hr/>
	\$100,523 25
Amount approved by the Board for payment,	. . . 95,513 11
	<hr/>
Balance January 1, 1908,	. . . \$5,010 14

#### (5) ANNUAL ASSESSMENTS.

Assessments for the year, amounting to \$270,448.12 for the North Metropolitan System and to \$503,860.49 for the South Metropolitan System, were required for the payment of interest and sinking fund requirements and the cost of maintenance and operation of works. The requirements for the North Metropolitan System were: for interest, \$123,858.39; for the sinking fund, \$53,144.64; and for maintenance, \$93,445.09. For the South Metropolitan System the requirements were: for interest, \$367,726.72; for the sinking fund, \$48,198.97; and for maintenance, \$87,934.80. The assessments for the North Metropolitan System were made upon the cities and towns

in the District in accordance with chapter 369 of the Acts of the year 1906, and the assessments for the South Metropolitan System were made in accordance with ratios fixed by the Apportionment Commissioners appointed under the provisions of chapter 424 of the Acts of the year 1899, and the respective assessments were as follows:—

*North Metropolitan Sewerage System.*

Arlington, . . . .	\$6,101 25	Somerville, . . . .	\$37,575 77
Belmont, . . . .	3,408 53	Stoneham, . . . .	3,358 50
Boston, . . . .	47,151 90	Wakefield, . . . .	5,443 92
Cambridge, . . . .	64,323 01	Winchester, . . . .	6,051 02
Chelsea, . . . .	17,399 54	Winthrop, . . . .	4,932 39
Everett, . . . .	14,384 62	Woburn, . . . .	7,487 56
Lexington, . . . .	2,331 25	Revere, . . . .	7,371 92
Malden, . . . .	20,965 22		
Medford, . . . .	12,896 77	Total, . . . .	\$270,448 12
Melrose, . . . .	9,264 95		

*South Metropolitan Sewerage System.*

Boston, . . . .	\$207,194 36	Quincy, . . . .	\$29,239 00
Brookline, . . . .	97,178 00	Waltham, . . . .	28,599 18
Dedham, . . . .	12,232 39	Watertown, . . . .	14,702 71
Hyde Park, . . . .	15,500 29		
Milton, . . . .	24,702 32	Total, . . . .	\$503,860 49
Newton, . . . .	74,512 24		

(6) EXPENDITURES FOR THE DIFFERENT WORKS.

The following is a summary of the expenditures made in the various operations for the different works:—

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
<i>North Metropolitan System.</i>		
Original system, main line and branches, .	-	\$5,383,932 67
Lexington branch, . . . . .	-	68,585 15
Everett branch, . . . . .	-	54,877 12
Wakefield branch, . . . . .	-	35,698 29
Stoneham branch, . . . . .	-	11,574 10
Chelsea and Everett outlets, . . . .	-	71,216 41
Belmont extension, . . . . .	-	57,153 06
Malden extension:—		
Administration, . . . . .	\$1,556 46	\$3,610 46
Section 64, . . . . .	2,689 80	45,829 94
Land takings, purchase and recording, .	2,274 45	4,439 05
	\$6,520 71	53,879 45
<i>Amounts carried forward, . . . .</i>	\$6,520 71	\$5,736,916 25

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
<i>Amounts brought forward,</i> . . . .	\$6,520 71	\$5,736,916 25
<i>North Metropolitan System—Con.</i>		
Bulkhead, Chelsea Creek, . . . .	3,231 00	3,231 00
Stable and locker, East Boston, . . . .	71 15	71 15
Revere extension, . . . . .	—	215,722 79
Wakefield branch extension, . . . .	—	190,081 97
Total North Metropolitan System, . . . .	<u>\$9,822 86</u>	<u>\$6,146,023 16</u>
<i>South Metropolitan System.</i>		
Charles River valley sewer, main line, . .	—	\$800,046 27
Neponset River valley sewer:—		
Main line, . . . . .	—	\$866,595 66
Brookline branch, . . . . .	—	44,935 80
		911,531 46
High-level Sewer:—		
Administration, . . . . .	\$27 86	\$51,621 43
Apportionment commission, . . . .	—	2,000 00
Land takings, purchase and recording, . .	126 63	355,501 45
Quincy force main, . . . . .	—	18,351 71
Quincy pumping station, . . . . .	9,564 14	11,705 68
Section 43, Quincy, . . . . .	—	411,749 22
Section 44, Quincy, . . . . .	—	299,543 47
Section 45, Quincy, . . . . .	—	76,139 36
Section 46, Quincy, . . . . .	—	62,551 26
Section 47, Quincy, . . . . .	—	109,786 58
Section 48, Quincy, . . . . .	—	295,319 29
Sections 48 and 49, embankments, Quincy, .	—	81,548 64
Section 49, Quincy, . . . . .	—	169,020 18
Section 50, Quincy, . . . . .	—	109,570 35
Section 51, Quincy, . . . . .	—	87,203 68
Section 52, Quincy, . . . . .	—	155,800 65
Section 53, Quincy, . . . . .	—	98,042 42
Section 54, Quincy, . . . . .	—	101,918 39
Section 55, Milton and Quincy, . . . .	—	305,816 90
Section 56, Milton, . . . . .	—	105,736 94
Section 57, Milton, . . . . .	—	68,783 24
Section 58, Milton, . . . . .	—	94,089 72
Section 59, Milton, . . . . .	—	104,444 62
Section 60, Milton, . . . . .	—	60,796 13
Section 61, Milton, . . . . .	—	129,598 76
Section 62, Milton, . . . . .	—	129,612 28
Section 63, Milton, . . . . .	—	127,142 45
Section 64, Neponset River crossing, . . .	—	47,554 40
Section 65, Hyde Park, . . . . .	—	41,333 37
Section 66, Hyde Park, . . . . .	—	253,902 72
Section 67, Hyde Park, Stony Brook cross- ing, . . . . .	—	32,298 33
Section 68, Hyde Park and Roxbury, . . .	—	78,493 62
Section 69, West Roxbury, . . . . .	—	102,143 68
Section 70, West Roxbury, . . . . .	—	131,375 55
<i>Amounts carried forward,</i> . . . .	<u>\$9,718 63</u>	<u>\$4,310,496 47</u> <u>\$1,711,577 73</u>



CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.	
<i>Amounts brought forward, . . .</i>	\$9,718 63	\$4,310,496 47	\$1,711,577 73
<i>South Metropolitan System—Con.</i>			
High-level Sewer— <i>Con.</i>			
Section 71, West Roxbury, . . . .	-	91,888 22	
Section 72, West Roxbury, . . . .	-	127,956 76	
Section 73, West Roxbury, . . . .	-	494,290 42	
Section 74, West Roxbury and Roxbury, .	-	147,296 69	
Section 75, Roxbury, . . . . .	-	137,192 99	
Section 76, Roxbury, cast-iron force main,	-	80,342 26	
Section 77, Roxbury, Ward Street pump- ing station, . . . . .	5,029 84	560,288 31	
Section 78, Roxbury, connecting sewer, .	-	35,994 69	
Reversion of grade, Huntington Avenue,	-	6,503 56	
	\$14,748 47		5,992,250 37
High-level extension:—			
Charles River valley studies, . . . .	-	\$3,893 71	
Administration, . . . . .	\$6,332 17	6,332 17	
Section 80, day work, West Roxbury and Brookline, . . . . .	177,405 52	200,045 89	
Section 81, Brookline, . . . . .	2,831 44	4,219 16	
Section 82, Brookline, . . . . .	112,634 88	114,022 60	
Section 82, day work, Park Street crossing,	2,019 54	2,019 54	
Section 83, Brookline, . . . . .	28,989 24	30,376 96	
Section 84, Brookline and Brighton, . .	43,664 87	45,052 59	
Section 85, Brighton, . . . . .	746 63	746 63	
Section 85, day work, Brighton, . . . .	64,646 05	66,254 61	
Section 86, Brighton, . . . . .	41 00	41 00	
Land takings, purchase and recording, .	5,747 83	5,747 83	
	445,059 17		478,752 69
Total for South Metropolitan System, .	\$459,807 64		\$8,182,580 79
Total for construction for both systems,	\$469,630 50		\$14,328,603 95

MAINTENANCE.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
North Metropolitan System, . . . . .	\$138,271 99	\$1,266,243 79
South Metropolitan System, . . . . .	95,513 11	1,114,060 05
Total for maintenance, both systems, .	\$233,785 10	\$2,380,303 84

## (7) DETAILED FINANCIAL STATEMENT.

The Board herewith presents, in accordance with the Metropolitan Sewerage Acts, an abstract of the expenditures and disbursements, receipts, assets and liabilities for the year ending December 31, 1907:—

(a) *Expenditures and Disbursements.*

GENERAL CHARACTER OF EXPENDITURES.		For the Year ending December 31, 1907.
CONSTRUCTION OF WORKS AND ACQUISITION BY PURCHASE OR TAKING.		
North Metropolitan System.		
Administration:—		
Commissioners, . . . . .	\$1,166 67	
Clerks and stenographers, . . . . .	235 00	
Stationery and printing, . . . . .	42 32	
Telephone, lighting, heating, water and care of building, . . . . .	20 88	
Rent and taxes, main office, . . . . .	90 59	
Miscellaneous expenses, . . . . .	1 00	
		\$1,556 46
Engineers, inspectors, rodmen, laborers and others, . . . . .	\$524 12	
Advertising, . . . . .	3 50	
Office supplies, . . . . .	81 15	
Books, maps, plans and blueprints, . . . . .	16 32	
Engineering supplies, . . . . .	3 56	
Rent and taxes, Ashburton Place, . . . . .	272 00	
Brick, cement, lumber and other field supplies, . . . . .	158 60	
Teaming and express, . . . . .	10 50	
Contracts:—		
T. H. Gill & Co., Section 64, . . . . .	\$1,048 18	
Sundry bills paid under this contract, . . . . .	643 02	
Lawler Bros., bulkhead Chelsea Creek, . . . . .	3,231 00	
		4,922 20
Land takings, purchase and recording, . . . . .	2,174 45	
Experts and appraisers, . . . . .	100 00	
		8,266 40
Total for North Metropolitan System, . . . . .		\$9,822 86
South Metropolitan System.		
High-level Sewer:—		
Administration:—		
Telephone, lighting, heating, water and care of building, . . . . .	\$16 96	
Miscellaneous expenses, . . . . .	10 90	
		\$27 86
Engineers, inspectors, rodmen, laborers and others, . . . . .	\$1,631 00	
Tools and repairs of same, . . . . .	59 17	
Brick, cement, lumber and other field supplies, . . . . .	12,846 21	
Teaming and express, . . . . .	57 60	
Land takings, purchase and recording, . . . . .	126 63	
		14,720 61
		\$14,748 47
High-level Sewer Extension:—		
Administration:—		
Commissioners, . . . . .	\$2,333 33	
Secretary, . . . . .	375 00	
Clerks and stenographers, . . . . .	2,099 00	
Traveling, . . . . .	8 00	
Stationery, printing and office supplies, . . . . .	833 86	
Amounts carried forward, . . . . .	\$5,649 19	\$14,748 47

GENERAL CHARACTER OF EXPENDITURES.		For the Year ending December 31, 1907.
Amounts brought forward, . . . . .	\$5,649 19	\$14,748 47
South Metropolitan System—Con.		
High-level Sewer Extension—Con.		
Administration—Con.		
Telephone, lighting, heating, water and care of building, . . . . .	343 10	
Rent and taxes, main office, . . . . .	293 53	
Miscellaneous expenses, . . . . .	46 35	
		\$6,332 17
Engineering:—		
Chief engineer, . . . . .	\$3,333 33	
Engineering assistants, . . . . .	23,710 75	
Inspectors, . . . . .	4,734 19	
Traveling expenses, . . . . .	361 46	
Stationery, printing and office supplies, . . . . .	1,027 44	
Engineering and draughting instruments and tools, . . . . .	151 00	
Engineering and draughting supplies, . . . . .	155 22	
Telephone, lighting, heating, water and care of building, . . . . .	1,390 58	
Rent and taxes, . . . . .	1,079 14	
Miscellaneous expenses, . . . . .	745 91	
		36,639 02
Advertising, . . . . .	\$411 67	
Labor and teaming, . . . . .	139,061 49	
Tools, machinery and appliances, . . . . .	2,308 00	
Brick, cement, lumber and other field supplies and expenses, . . . . .	87,997 00	
Contracts:—		
Hugh Nawn Contracting Co., Section 81, in part, . . . . .	1,496 00	
James Driscoll & Son, Section 82, in part, . . . . .	36,755 84	
Timothy J. O'Connell, Section 82, in part, . . . . .	26,122 68	
Timothy J. O'Connell, Section 82, in part, . . . . .	38,085 05	
Chas. G. Craib & Co., Section 83, in part, . . . . .	23,225 85	
Timothy J. O'Connell, Section 83, in part, . . . . .	2,085 05	
D. F. O'Connell, Section 84, . . . . .	38,741 52	
		396,290 15
Real estate:—		
Settlements, . . . . .	\$5,582 20	
Legal, conveyancing and expert, . . . . .	165 63	
		5,747 83
		445,059 17
Total for South Metropolitan System, . . . . .		\$459,807 64
MAINTENANCE AND OPERATION OF WORKS.		
North Metropolitan System.		
Administration:—		
Commissioners, secretary and assistants, . . . . .	\$5,661 67	
Postage, printing, stationery and office supplies, . . . . .	543 18	
Rent, telephone, heating, lighting and care of building, . . . . .	578 86	
Miscellaneous expenses, . . . . .	61 35	
		\$6,845 06
Amount carried forward, . . . . .		\$6,845 06

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1907.	
<i>Amount brought forward,</i> . . . . .		\$6,845 06
<i>North Metropolitan System — Con.</i>		
General superintendence:—		
Chief engineer and assistants, . . . . .	\$6,182 12	
Postage, printing, stationery and office supplies, . . . . .	219 23	
Rent, telephone, heating, lighting and care of building, . . . . .	1,618 04	
Miscellaneous expenses, . . . . .	431 30	
Deer Island pumping station:—		\$450 69
Labor, . . . . .	\$13,751 21	
Coal, . . . . .	9,220 83	
Oil and waste, . . . . .	410 75	
Water, . . . . .	1,117 20	
Packing, . . . . .	168 06	
Repairs and renewals, . . . . .	1,659 85	
Telephone and office supplies, . . . . .	183 33	
Miscellaneous supplies and expenses, . . . . .	1,523 56	
East Boston pumping station:—		
Labor, . . . . .	16,885 79	
Coal, . . . . .	11,971 71	
Oil and waste, . . . . .	403 57	
Water, . . . . .	1,396 80	
Packing, . . . . .	44 37	
Repairs and renewals, . . . . .	1,385 09	
Telephone and office supplies, . . . . .	134 52	
Miscellaneous supplies and expenses, . . . . .	1,144 10	
Charlestown pumping station:—		
Labor, . . . . .	14,173 37	
Coal, . . . . .	4,485 49	
Oil and waste, . . . . .	288 67	
Water, . . . . .	411 60	
Packing, . . . . .	63 28	
Repairs and renewals, . . . . .	746 64	
Telephone and office supplies, . . . . .	167 00	
Miscellaneous supplies and expenses, . . . . .	455 30	
Alewife Brook pumping station:—		
Labor, . . . . .	6,020 94	
Coal, . . . . .	1,832 20	
Oil and waste, . . . . .	189 33	
Water, . . . . .	170 16	
Packing, . . . . .	15 43	
Repairs and renewals, . . . . .	150 85	
Telephone and office supplies, . . . . .	129 80	
Miscellaneous supplies and expenses, . . . . .	90 56	
Sewer lines, labor, . . . . .		\$90,791 36
Supplies and expenses, . . . . .	\$22,440 94	
Horses, vehicles and stable account, . . . . .		24,459 57
Meeting House Brook Crossing, labor, . . . . .		7,217 41
Supplies and expenses, . . . . .	\$282 90	
Total, . . . . .		507 90
		\$138,271 99

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1907.	
<i>South Metropolitan System.</i>		
Administration:—		
Commissioners, secretary and assistants, . . . . .	\$3,288 33	
Postage, printing, stationery and office supplies, . . . . .	544 09	
Rent, telephone, heating, lighting and care of building, . . . . .	506 17	
Miscellaneous expenses, . . . . .	90 17	
		\$4,428 76
General superintendence:—		
Chief engineer and assistants, . . . . .	\$4,484 63	
Postage, printing, stationery and office supplies, . . . . .	191 19	
Rent, telephone, heating, lighting and care of building, . . . . .	1,501 38	
Miscellaneous expenses, . . . . .	501 34	
		6,678 54
Ward Street pumping station:—		
Labor, . . . . .	\$17,719 34	
Coal, . . . . .	8,280 46	
Oil and waste, . . . . .	388 98	
Water, . . . . .	1,318 80	
Packing, . . . . .	845 18	
Repairs and renewals, . . . . .	539 88	
Telephone and office supplies, . . . . .	181 59	
Miscellaneous supplies and expenses, . . . . .	2,064 25	
Quincy pumping station:—		
Labor, . . . . .	6,332 61	
Coal, . . . . .	1,938 01	
Oil and waste, . . . . .	53 82	
Water, . . . . .	191 55	
Packing, . . . . .	43 30	
Repairs and renewals, . . . . .	18 66	
Telephone and office supplies, . . . . .	76 10	
Miscellaneous supplies and expenses, . . . . .	491 81	
Nant Island screen-house:—		
Labor, . . . . .	6,752 37	
Coal, . . . . .	1,789 02	
Oil and waste, . . . . .	35 64	
Water, . . . . .	316 28	
Packing, . . . . .	8 82	
Repairs and renewals, . . . . .	127 53	
Telephone and office supplies, . . . . .	79 69	
Miscellaneous supplies and expenses, . . . . .	601 69	
		50,195 38
Sewer lines, labor, . . . . .		
Supplies and expenses, . . . . .	\$21,599 69	
	1,538 18	
		23,137 87
City of Boston, for pumping and interest, . . . . .		7,700 00
Horses, vehicles and stable account, . . . . .		3,372 56
Total, . . . . .		\$95,513 11

## (b) Receipts.

The receipts from the sales of property, from rents and from other sources, have been credited as follows:—

ACCOUNT.	For Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
North Metropolitan System,—construction, . . .	-	\$17,153 40
South Metropolitan System,—construction, . . .	\$3,228 13	10,106 60
North Metropolitan System,—maintenance, . . .	1,225 04	9,415 00
South Metropolitan System,—maintenance, . . .	23 25	1,102 18
Metropolitan Sewerage Loans Sinking Fund, . . .	109 21	1,019 41
Totals, . . . . .	\$4,585 63	\$38,796 59

(c) *Assets.*

The following is an abstract of the assets of the Sewerage Works, a complete schedule of which is kept on file in the office of the Board:—

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; real estate connected with works not completed; completed works, including real estate connected therewith.

(d) *Liabilities.*

There are liabilities as follows:—

Due on monthly pay rolls, . . . . . \$1,455 54

There are other current bills unpaid, which have not yet been received.

*Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.*

NAME.	Work.	Amount.
High-level Sewer:—		
National Contracting Co., . . .	Sect. 73, contract abandoned,	\$5,516 17 <sup>1</sup>
E. W. Everson & Co., . . .	Sect. 75, . . . . .	1,000 00
High-level Sewer Extension:—		
Hugh Nawn Contracting Co., . . .	Sect. 81, in part, . . .	264 00
James Driscoll & Son, . . .	Sect. 82, in part, . . .	6,486 39
Timothy J. O'Connell, . . .	Sect. 82, in part, . . .	4,609 93
Timothy J. O'Connell, . . .	Sect. 82, in part, . . .	6,720 95
Chas. G. Craib & Co., . . .	Sect. 83, in part, . . .	3,975 15
Timothy J. O'Connell, . . .	Sect. 83, in part, . . .	367 95
D. F. O'Connell, . . .	Sect. 84, . . . . .	2,354 82
North Metropolitan Construction:—		
T. H. Gill & Co., . . . . .	Sect. 64, . . . . .	2,387 77
		\$33,683 13

<sup>1</sup> Damages claimed on account of the abandonment of the contract exceed this amount.



On the claims of the following it is impossible to state the amounts due for land and other damages, as no sums have been agreed upon, and suits are now pending in the courts for the determination of most of them: —

Boston Elevated Railway Company, Boston & Maine Railroad, Anna L. Dunican, Carrie S. Urquhart, N. Jefferson Urquhart, Edwin N. Urquhart, Richard Jones, James Doherty, Michael Niland, Michael Cashman, William H. Gibbons, Francis Normile, Crescent Land Company, George A. Goddard.

#### VIII. CONSUMPTION OF WATER.

The average daily quantity of water consumed by the cities and towns supplied by the Metropolitan Water Works was greater than the quantity so consumed in the previous year by 6,251,000 gallons, the daily quantity consumed being 125,071,000 gallons. The increase in the average daily consumption per inhabitant during the year was 3.8 gallons per day, the daily per capita consumption having reached the amount of 133.8 gallons. The above measurements are of the quantities of water as it is delivered from the various sources of supply.

There was an increase in the per capita daily consumption in 10 of the municipalities of the District, in 3 there was no change, and in 5 there was a decrease in the quantity. The large increase during the year is due in a great measure to the very cold weather which prevailed during the months of January and February, when water was allowed to run to waste in order to prevent the freezing of the water pipes. Another cause for the increase, especially in suburban districts, was the dry weather in July and August, when large quantities of water were used for the watering of gardens and lawns.

The most striking increase in the consumption is found in the town of Stoneham, where the daily per capita consumption increased from 69 gallons to 93 gallons, or 24 gallons per inhabitant. This increase is undoubtedly due to leakage in the local pipe system, and will cause a considerable increase in the water assessment of that town. There has been a large increase in the daily per capita consumption in the towns of Arlington and Belmont, largely on account of the use of water for gardening purposes. The increase in the per capita consumption in the city of Boston was from 151 gallons to

157 gallons per day, making a total increase of 5,471,000 gallons per day. The decrease in the per capita consumption occurred in the cities of Malden and Quincy, and in the towns of Lexington, Swampscott and Milton.

The large amount of water which is unnecessarily consumed or wasted is undoubtedly due to bad plumbing and the continued existence of leakages, as well as to the fact that in the coldest season the water is on many of the premises allowed to run continuously in order to prevent the freezing of pipes. The daily average consumption for the coldest week of the year was 154,500,000 gallons, or 30,364,900 gallons above the daily average for the year. The fact that the average consumption of water, as shown by the passage of the water through the pipes, between the hours of 1 and 4 in the morning, when but a very small quantity can be used for any legitimate or necessary purpose, amounts to an average daily rate per year of 84,000,000 gallons, and in the coldest weather reaches a point as high as at the rate of 110,000,000 gallons per day, or 88 per cent. of the entire consumption, proves not only that the water is constantly running to waste throughout the District,<sup>1</sup> but also that this wastefulness occurs to a large extent on account of leakage of the local water pipes and bad plumbing in the houses.

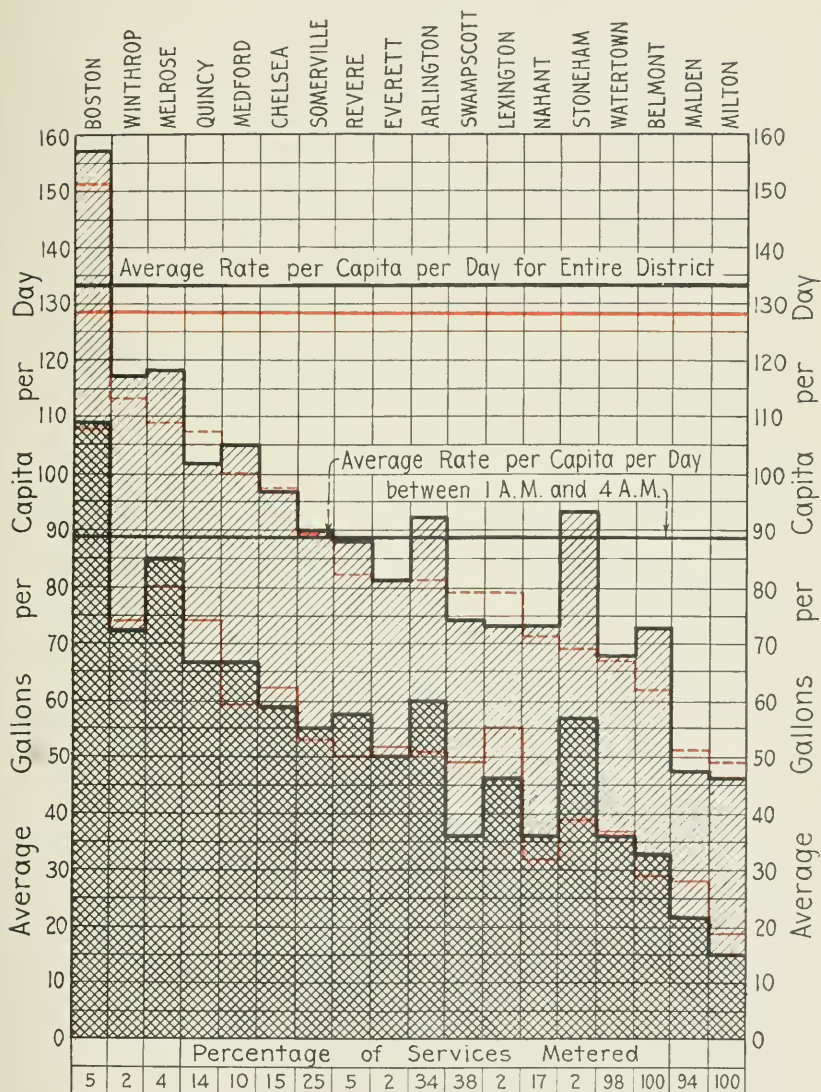
The number of new meters which have been set during the past year in the cities and towns supplied by the Metropolitan Water Works was 4,334, — an increase of 77 over the total last year. The greater number of these meters were set in the cities of Melrose, Chelsea, Quincy and Somerville, and in the town of Swampscott, in which were installed a very large number in proportion to the population.

A comparison of the per capita consumption of water in cities and towns where meters are in general use with the consumption of other cities and towns where meters are not generally installed, proves conclusively the salutary effect of meters in reducing unnecessary consumption. In the four municipalities of Milton, Malden, Belmont and Watertown, where the services are generally metered, the daily average consumption in the month of February varied from 40 gallons to 61 gallons per inhabitant. In the four municipalities of Revere, Melrose, Winthrop and Chelsea, where the general conditions are similar but where the services are not generally metered,

---

<sup>1</sup> This is graphically illustrated by the accompanying diagram.

DIAGRAM SHOWING  
 AVERAGE RATE OF CONSUMPTION OF WATER  
 IN THE METROPOLITAN DISTRICT IN 1907  
 DURING THE ENTIRE DAY  
 AND  
 BETWEEN THE HOURS OF 1 AND 4 AT NIGHT



Daily Average Rate of Consumption 1907.....  
 " " " Night " between 1 A.M. and 4 A.M. 1907.....  
 Daily Average Rates of Consumption in 1906 shown in red -----



the average daily consumption per inhabitant varied from 111 to 156 gallons in the same month.

The Legislature of last year passed an act providing that all municipalities taking their water supply from the Metropolitan Water Works should, after December 31, 1907, equip with water meters all services thereafter installed, and should annually equip with water meters 5 per cent. of the services which were then unmetered, and should thereafter charge each consumer in proportion to the amount of water used. Inasmuch as the Act goes into operation only with the current year, it has not affected the consumption of water.

The quantity of water used has now become the most important element in determining the amount of the assessment payable by each city and town in the Metropolitan District for the construction and maintenance of the Water Works, the sum assessed being based one-third upon the taxable valuation and two-thirds upon the consumption of water of each municipality. It is made an incentive not only for the District as a whole, but for each municipality, to check and to stop the unnecessary and wasteful consumption of water, which now reaches from one-third to one-half of the total amount supplied from the Water Works.

It has been demonstrated by the experience of the town of Milton and the city of Malden, where the consumption has been reduced to 46 and 47 gallons respectively for each inhabitant per day, as against the average consumption of more than 133 gallons for each inhabitant per day in the whole District, that the general introduction of meters, accompanied by the prompt prevention of leaks in street mains, will greatly reduce the consumption of water.

The want of rigorous inspection and the failure at once to check extensive leakages indicated has probably increased the assessment of the town of Stoneham for the current year by about 18 per cent.: while two years ago the discovery of leaks in street mains and their prompt repair reduced the consumption of water in that town by more than one-half.

The gradual installation of more meters in the city of Boston, the institution of stricter inspection, and the prompt suppression of defects and abuses, while entailing some additional present outlay, would go far towards decreasing assessments in that city, and postponing for years the necessity for seeking further sources of water



supply and the construction of new large and expensive works. Great expenditures in the near future are inevitable if the present increasing rate of consumption in that city, now amounting daily to 157 gallons per inhabitant, shall continue.

The duty of preventing unnecessary and wasteful consumption of water is laid upon each municipality, not only for the protection of the financial interests of its own citizens, but in justice to the residents of those other districts of the Commonwealth whose lands must be taken and other properties affected in value and whose business interests must be impaired when the exigency arises for the further extension of the sources of water supply.

### IX. ELECTROLYSIS.

Investigations have been made during the year for determining the general electrical action upon the pipe lines throughout the distribution system by the tracks of the electric street railways. In several places there was found indication of an increasing rate of injury resulting from the electric current. Many new gaging stations have been installed for the purpose of making more accurate determinations of the currents of electricity flowing upon the pipe lines.

Two additional insulating joints have also been placed, one in Chelsea and the other in Malden, not only for the purpose of ascertaining the direction and intensity of the electric currents upon the pipe lines, but also for controlling the flow of electricity.

At various points along the large water mains the pipes have been uncovered in order to ascertain the extent of the permanent injury which has been produced by electricity. The investigations show that the pitting and disintegration of the pipes from the electrical action has reached a serious extent, and the disintegrating process is continuing even in places where insulating joints and other devices have been applied for the purpose of arresting or overcoming the injury which is caused by the underground electric currents.

Measures will be taken not only for ascertaining the amount of the damage which has been caused, but also in order to determine the responsibility for the injury which arises from electrolysis, while all means which promise success will be adopted for the protection of the pipes.





42-INCH WATER PIPE IN CHELSEA PITTED BY ELECTROLYSIS.



## X. LEGISLATIVE ACTS OF THE YEAR 1907.

The Legislature of the year 1907 appropriated (chapter 201) a sum not exceeding \$143,000 for the cost of maintenance and operation of the North Metropolitan Sewerage System, and (chapter 200) a sum not exceeding \$105,000 for the cost of maintenance and operation of the South Metropolitan Sewerage System.

It was provided by chapter 165 that annual appropriations should thereafter be made for the maintenance and operation of the Metropolitan Water System, and that balances remaining on account of assessments in any one year should be taken into account in making the assessments of the succeeding year.

It is provided by chapter 238 that all sums of money paid by a city or town not belonging to the Metropolitan Water District, or by a water company in any such city or town, for water furnished to it by the Board, shall hereafter be applied to the Metropolitan Water Loan Sinking Fund, instead of being distributed to the cities and towns in the District, as before required by the Metropolitan Water Act.

Chapter 349 so amended the Metropolitan Water Act that the Board is empowered, on payment of a proper amount of money, in case of fire or other emergency, to furnish water to a city, town or water company within the Metropolitan Water District, as well as to a city, town or water company which is outside of the ten-mile limit prescribed for the Metropolitan Water District.

By chapter 524, cities, towns, districts or corporations which derive all or any part of their water supply from the Metropolitan Water Works or from sources used by or under the control of the Metropolitan Water District are required, after the year 1907, to equip with water meters all services thereafter installed for them, and annually thereafter to equip with meters in like manner 5 per cent. of the water services which were unmetered on December 31, 1907, and thereafter also to charge each consumer for water furnished in proportion to the amount of water used. The provisions of the act, however, do not apply to the water services used for fire purposes only. Provision is made for the necessary care, testing and replacing of meters, and it is required that proceedings for the enforcement of the provisions of the act shall be instituted and

prescribed by the Attorney-General, upon the complaint of any party in interest.

Chapter 269 extended the provisions relative to the hours of labor, so as to require that no laborer, workman or mechanic employed by or in behalf of the Commonwealth should be required to work more than eight hours in any one calendar day or more than forty-eight hours in any one week, except in cases of extraordinary emergency; and it was further provided by chapter 577 that, except in cases of emergency or except at the request of the employé, it should not be lawful to require an employé engaged in the work of any industrial process to do such work on the Lord's Day, unless such employé should be allowed during the six days next ensuing twenty-four consecutive hours without labor.

#### XI. RECOMMENDATIONS FOR ADDITIONAL WATER AND SEWERAGE LOANS.

The Board, in its abstract of the annual report to the Legislature at the beginning of the session of the year 1908, made the following statements and recommendations regarding additional water loans for necessary construction for the coming year and for the discharge of liabilities already accrued and existing:—

It appears from the foregoing financial statement that on December 1, 1907, the balance remaining on account of the Metropolitan Water Loan Fund, for the construction and acquisition of works, was \$193,903.93.

There are remaining unpaid certain reserves retained under contracts which have been completed, and there are still unsettled a considerable number of suits and claims arising under contracts for the construction of the Wachusett Dam and Reservoir, and suits for damages to lands and other properties and business in the Wachusett watershed. The Board is of the opinion that a sum considerably in excess of the balance of the Metropolitan Water Loan Fund remaining on hand December 1, 1907, will be required to pay for the existing indebtedness. It is anticipated that payment of by far the larger part of this indebtedness will be called for out of the present balance or coming appropriation, and it is quite possible that the entire amount will be payable during the current year, or before an appropriation for the next year would become available.

There being a considerable balance on hand at the close of the previous fiscal year, the Legislature of last year made no appropriation for the construction and acquisition of works.

The operations of the Board during the past year have been confined to the completion of work already begun or whose construction had been provided



for. The expenditures have been principally made for small additions required for the completion of the Wachusett Dam; for the repair and improvement of the North Dike; toward the completion and equipment of the Arlington pumping station, and improvements at the Chestnut Hill pumping station; for work upon the bed of the Wachusett Reservoir, necessitated by the gradual filling of the reservoir with water; and in the settlement of existing claims and suits for damages. Only such work as seemed to be urgently demanded under the plans originally laid out has been done during the past year for the improvement of the watershed and for preventing the pollution of the water supply.

There are important works whose necessity was contemplated to arise under the original scheme adopted by the Water Act of 1895, which were to be undertaken in the second ten years after the passage of the Water Act of 1895. It is the purpose of the Board to defer the construction of such new works until they are urgently called for by the exigencies of the water supply.

There are, however, two objects for which it seems necessary for the Legislature to make provision during the coming year.

The original Water Act provided that the Board might use the fall of water at any dam under its charge, and might produce and transmit power or electricity and sell the same. The gate-house at the base of the Wachusett Dam has been so constructed that a power plant may be installed in it. The reservoir is now rapidly filling with water, and the time will soon come when it will be possible to utilize the power which can be generated at the dam.

In none of the loans which have been authorized has any provision been made for the construction of the power plant; and it would seem to be proper, if not necessary, that money which may be required for such a purpose — for the carrying on of a business, and not for the purpose of a water supply — should be specifically appropriated, and special authority be given for the expenditure of the required amount from the water loan fund.

Preliminary estimates have been made of the amount which would be required for a plant for the production of power at the dam; and the Board is now engaged in the investigation of the various questions arising as to the production of power, and the means and opportunity for its disposal when manufactured. Whether power can be so produced of a sufficiently marketable character, and can be disposed of at prices sufficient to ensure the Commonwealth against loss in the operation, is in part dependent upon the valuation of the power plant for local taxation.

If the Board reaches the conclusion that favorable arrangements can be made for the construction of the plant and its profitable operation, legislation will be required to authorize the Board to enter into such arrangements, and also a proper provision will have to be made for an additional water loan to defray the cost of construction.

There is a necessity that speedy action shall be taken for increasing the pressure of the water supplied to the low district of the city of Boston. The rapid increase in the water consumption in this district has been such as to make the pressure inadequate for many of the higher buildings, and to

cause possible danger in case of fire, as well as considerable inconvenience and annoyance at times to water takers. The Board has reached the conclusion that the feasible remedy for the troubles which exist lies in the construction of a new water main from the Chestnut Hill Reservoir, through the intervening portion of the town of Brookline, to the boundary line of the city of Boston.

No new main for the supply of that city has been laid since a date many years previous to the taking over of the Boston Water Works by the Metropolitan Water Board.

No other large work of construction is anticipated as required during the coming year. It is deemed necessary, however, by the Board to continue the work originally called for by the report of the State Board of Health, and which has been gradually carried out, of removing the more threatening sources of pollution, and adopting measures for the purification of the water supplied to the District. This work is carried on by the ditching of noxious swamps; the cleaning of filthy ponds and streams; the turning of polluting house and farm drainage and brooks and streams into cesspools and filter-beds; and, in occasional instances, the acquiring possession of properties which are a permanent menace to the water supply. Small additions are required at the Wachusett Dam, and some further work will be required for the removal of soil made necessary by the filling of the Wachusett Reservoir.

The Arlington pumping station has been in process of construction during the year, and its equipment will be completed early in the current year.

The Board accordingly recommends that authority may be given for additional water loans, to be issued from time to time as may be required for the above purposes, to a total amount not exceeding \$450,000. It is estimated that this amount will be required for expenditures as follows:—

For power plant at Wachusett dam, . . . . .	\$115,000 00
For concrete walls and tile floor at Wachusett dam, . . . . .	7,000 00
For new 48-inch main from Chestnut Hill reservoir to Boston line, . . . . .	200,000 00
For minor additions to the Wachusett dam, . . . . .	3,700 00
For work at the Wachusett reservoir, . . . . .	2,000 00
For completion of the Arlington pumping station and its equipment, . . . . .	14,500 00
For the construction of sewers, cesspools and other improvements necessary on the Wachusett watershed, . . . . .	15,000 00
For engineering and administration expenses chargeable to construction, . . . . .	27,500 00
For settlement of suits and claims, and for reserves payable upon completed contracts, . . . . .	260,000 00
Total, . . . . .	<u>\$644,700 00</u>
Balance remaining on hand December 1, 1907, . . . . .	193,903 93
	<u>\$450,796 07</u>

It is pertinent to add that of the expenditures, which it is above recommended that the Board shall have authority to make, a considerable portion is for the construction of works which will yield a return, and lessen rather than increase the assessments that the Metropolitan District will be called upon to pay. The other expenditures, other than those required for the



payment of existing indebtedness, are mostly made necessary on account of the increasing consumption of water, for which the various municipalities in the District receive a return by means of increased collections of water rates.

According to the report of the Treasurer of the Commonwealth, while the assessments for the payment not only of the current expenses of maintenance and interest on the Commonwealth's indebtedness, but also of the sums called for by the sinking fund to extinguish the debt in a series of years, and which are entirely paid by the municipalities of the District, amounted, for the year 1906, to \$2,262,657.20, the sums collected by the various cities and towns in water rates amounted to \$3,568,184.83. It is believed that the excess of receipts over assessments is more than the amount of all the expenditures annually incurred in the distribution of water; that in many of the municipalities there is a current yearly balance of municipal revenue over expenditure in the municipal water supply accounts; and that the quality of the water has been much improved, while in no case have the rates payable by the individual water takers been increased, by the introduction of the Metropolitan Water Supply System.

The Board also recommended that authority be given for additional sewerage loans for the North Metropolitan System, and made the following statements relative to the necessity for such loans:—

The Board has for a considerable period been desirous of constructing a building or group of small buildings near the East Boston pumping station, to be used as a stable and locker and for the general purposes of the North Metropolitan Sewerage System. The buildings now used for these purposes are temporary structures, put up to supply the needs for the time being until permanent buildings could be erected. Permanent construction has been deferred on account of questions arising as to the proposed location of the buildings. The Board has reached the conclusion that they should be built upon the present location, and that the work of construction ought now to be begun. The balance remaining unexpended on the North Metropolitan Sewerage Loan Fund (\$31,995.97) is more than sufficient to defray the cost of the work; but, inasmuch as this object was not specified when the loans, from which a balance remains, were authorized, the Board desires authority from the Legislature to use such portion of the balance as is necessary for this purpose.

The Board is obliged to call the attention of the Legislature to the necessity of providing in the near future additional sewage pumping facilities for the North Metropolitan District. The pumping plants at East Boston and Deer Island are already becoming inadequate for the work which they are called upon to do.

The Metropolitan Sewerage Commission, at the time that these plants were built and installed, gave the ultimate quantities of sewage for which the plants were designed to provide. It was expected that these quantities would not be reached for a long period to come. It, however, appears that at both

the East Boston and Deer Island stations the quantities assumed as the maximum capacities of the plants have already been attained, and that the average quantities which they were expected to pump have been surpassed in the wetter months of the year. These results have naturally arisen from the greater increase of population and the far greater consumption of water than was anticipated by the former Sewerage Commission. During prolonged periods all the pumps at these stations must be kept in continuous operation, and there is no reserve in case of breakdown or other accident. Several of the boilers also have been in constant service for the eighteen years which have elapsed since their construction, and have about reached the time limit of endurance and safety.

The amount necessary for the additions to these plants is considerable, as the additions involve not only a new pumping engine in each station and new boilers, but also enlargements of the engine houses and additional coal-storage rooms. Three or four years will be required to install and equip the additional plants, and the Board is of the opinion that the beginning of the work cannot safely be deferred for another year. The expenditures necessary would extend over a period of at least three years.

The Board recommends that authority be given for additional sewerage loans for the North Metropolitan System, to be issued from time to time as may be required for these purposes, to an amount not exceeding \$485,000. It is estimated that this amount will be required for expenditure as follows:—

For stable and locker buildings at East Boston, . . . . .	\$15,000 00
For East Boston pumping station extension:—	
Expenditures in 1908, . . . . .	\$80,000
Expenditures in 1909, . . . . .	123,000
Expenditures in 1910, . . . . .	77,000
	<hr/>
	280,000 00
For Deer Island pumping station extension:—	
Expenditures in 1908, . . . . .	\$45,000
Expenditures in 1909, . . . . .	103,000
Expenditures in 1910, . . . . .	72,000
	<hr/>
	220,000 00
	<hr/>
	\$515,000 00
Balance on hand December 1, 1907, . . . . .	31,995 97
	<hr/>
	\$483,004 03

The work of constructing the extension of the High-level Sewer of the South Metropolitan System has been making successful progress during the past year, and will approach completion during the current year. It is believed that the balance now on hand for that system will be sufficient to meet all the expenses for construction during the year.



STEEL FORMS FOR PLACING CONCRETE MASONRY LINING IN TUNNEL—HIGH LEVEL SEWER EXTENSION.



## XII. SEWERAGE AND WATER ASSESSMENTS.

The sums necessary to meet the expenses of the maintenance and operation of the Sewerage Works, the payments of interest on the bond indebtedness, and the requirements of the sinking funds, have but gradually changed from year to year. The assessments actually levied upon the municipalities have, however, for certain reasons, greatly varied in recent years.

Prior to the year 1907 premiums received from the sale of bonds were applied to the reduction of the assessments. In one year, 1903, for instance, the premiums from bond sales reduced the assessments in the South Metropolitan Sewerage District to three-fifths of what they otherwise would have been. The Statute of 1906, chapter 338, however, provided that premiums thereafter so received should be paid into the sinking fund and not be applied to the reduction of the yearly assessments.

It was recently determined by the Treasurer of the Commonwealth to be desirable to have the State books of accounts dealing with the various Metropolitan districts examined in order "to make sure that no errors had occurred in the accounting between the State and the districts up to the present time." A careful examination of all the accounts with the Treasurer's department relating to the districts was accordingly made, and, in compliance with the report of the accountant and his recommendations, it was found necessary to make certain adjustments in the various funds. The Treasurer accordingly caused additions to be made to some funds and reductions from others. Under these adjustments by the Treasurer the assessments of the North Metropolitan Sewerage District for the year 1907 were reduced by \$114,446.52, or about 32 per cent., from what they otherwise would have been; while in the same way the assessments of the South Metropolitan District were increased by \$91,997.34, or more than 22 per cent., above what they otherwise would have been for that year. These exceptional variations in the assessments for the year 1907 must necessarily be taken into account by the cities and towns in the two districts in making up their estimates of the amount of the assessment which will be levied for the current year in their respective municipalities.



Sums received from sales of bonds and also sums paid by municipalities on admission into the Metropolitan Water District have in a similar manner been applied to reducing the amounts of the assessments made upon the cities and towns in the Water District for the years of their receipt. These also, in accordance with the Statute of 1906, will hereafter be paid into the sinking fund.

The adjustments of accounts made by the Treasurer, above referred to, caused a deduction in the total assessments upon the cities and towns in the Metropolitan Water District of \$75,509.80 from the amount which otherwise would have been payable to meet the requirements of maintenance, interest and sinking funds. This exceptional reduction in the assessments for the year 1907 will also have to be considered by the cities and towns in the Water District when estimates are made of the sums which will be required for the current year.

### XIII. FUTURE WORK.

The Board has estimated that the total amount of \$684,000 will be required during the coming year for the maintenance and operation of the various works for water supply and distribution of water to the cities and towns of the Metropolitan Water District, and of the works constructed for the collection and disposal of the sewage of the municipalities of the Metropolitan Sewerage District.

There was comparatively little additional construction in connection with the Water Works carried on during the past year, although considerable was required to be done in the finishing up of the Wachusett Dam and Reservoir and other works which had been begun, and in meeting the most pressing demands which arose for the sanitary improvements upon the watersheds and for the protection of various sources of water supply against pollution.

There are still important works remaining to be built under the requirements placed upon the Board by the Metropolitan Water Acts, which, in the original scheme of the State Board of Health, were for the most part deemed necessary to be supplied in the second period of ten years succeeding the year 1895. There are also additional requirements made necessary by the growth of districts or by special local circumstances. It has been the policy of the Board to defer the beginning of the construction of such works until the necessity for them becomes demonstrated and urgent.



It is at the same time made the duty of the Board to represent the existing conditions, and to ask for the necessary appropriations required to supply the needs and to "provide a sufficient supply of pure water" for the various cities and towns constituting the Metropolitan Water District and for the inhabitants thereof.

The Board, in its abstract of the Annual Report, which was laid before the Legislature on the third Wednesday in January, enumerated the various objects of construction for which it deemed necessary to make provision during the current year. These, as set forth upon a preceding page, included the construction of a new 48-inch main from Chestnut Hill Reservoir to the Boston line, more especially for the relief of the low-service district of the city of Boston. The Board also stated that it was believed that the time had come when it should take measures to utilize the opportunities for generating power at the Wachusett Dam, as contemplated by the Metropolitan Water Act.

If the present rate of water consumption continues unchecked for one or two years longer, it will undoubtedly be necessary to proceed to lay a second 48-inch main from the terminus of the Weston Aqueduct into the Metropolitan District, and to make extensive additions to the pumping plant at Chestnut Hill. In like manner further pipe lines will be absolutely required in the northern part of the Metropolitan District.

It is hoped that the Board will be able during the coming year to effect a settlement, through the courts or otherwise, of the various suits and claims brought in connection with the Water Works for damages still unadjusted on account of the construction of the Wachusett Dam and Reservoir, and on account of alleged depreciation in value of property not taken and injuries caused by the operations of the Board to estates and to established business in towns where the reservoir is located.

It is expected that the construction of the extension of the High-level Sewer in the South Metropolitan Sewerage District will approach completion during the coming year. The further extension of the sewer through the city of Newton will probably not be required for a few years to come, unless additions are made to the District.

The construction of the North Metropolitan System was begun about nineteen years ago, and, on account of the large increase in the population and business of the territory constituting the District

and the still greater increase in the amount of sewage which must be received, it is becoming necessary to make considerable enlargements and extensions and to renew some of the works which have reached the limit of their capacity or period of safe operation. The Board has accordingly in its recommendations to the Legislature asked for authority to make additions to the East Boston and Deer Island sewerage pumping stations, and to install and equip additional plants in them. The situation at these pumping stations seems to call most urgently for relief.

There are other parts of the system to which relief must be extended in a comparatively short period of time. This is particularly the case with the portion of the Mystic valley main sewer, which receives the sewage of the city of Woburn and town of Winchester. This main sewer has so nearly reached the limit of its capacity that it is inadequate in times of heavy rains to dispose of all the contents of the local sewers, and as a result considerable quantities of the sewage and manufacturing wastes diluted with storm water overflow in different localities through the manholes. The situation is such that a new main sewer in this district will probably soon be called for.

The detailed reports of the Chief Engineer of the Water Works and of the Chief Engineer of the Sewerage Works, with various tables and statistics, are herewith presented.

Respectfully submitted,

HENRY H. SPRAGUE.  
HENRY P. WALCOTT.  
JAMES A. BAILEY, JR.

Boston, February 26, 1908.

## REPORT OF CHIEF ENGINEER OF WATER WORKS.

---

*To the Metropolitan Water and Sewerage Board.*

GENTLEMEN:—The following is a report of the operations of the Engineering Department of the Metropolitan Water Works for the year ending December 31, 1907.

### ORGANIZATION.

The principal changes in the personnel during the year have been the resignation of Frederic P. Stearns from the office of Chief Engineer, which occurred on February 1, and of Alexander E. Kastl, Division Engineer in charge of the Wachusett Department, on August 20.

Mr. Stearns, with Joseph P. Davis and Hiram F. Mills, have been retained to act as consulting engineers upon important questions.

The principal assistants employed under the direction of the Chief Engineer at the close of the year were as follows:—

Elliot R. B. Allardice,	. Superintendent, Wachusett Department.
Charles E. Haberstroh,	. Superintendent, Sudbury Department.
George E. Wilde,	. Superintendent, Pipe Lines and Reservoirs, Distribution Department.
Arthur E. O'Neil,	. Superintendent, Pumping Stations, Distribution Department.
William E. Foss,	. Division Engineer.
Alfred O. Doane,	. Division Engineer.
Benjamin F. Hancox,	. Assistant in Charge of Drafting Department.
Samuel E. Killam,	. Office Assistant.
Arthur W. Walker,	. Biologist.
William W. Locke,	. Sanitary Inspector.

At the beginning of the year the engineering force, including those engaged upon both the construction and maintenance of the works, numbered 48, and at the end of the year 45.

There has also been a maintenance force, exclusive of the engineers above mentioned, averaging 234, employed in the operation of the several pumping stations and in connection with the maintenance of the reservoirs, aqueducts, pipe lines and other work.

Special gangs of men have been employed in repairing and strengthening the North Dike, in constructing ditches for the drainage of swamps in Holden and Princeton, and in cleaning weeds from the bottom of the unfilled portion of the Wachusett Reservoir. The number of men employed on construction, exclusive of those employed by contractors, has averaged 93.

#### ARRANGEMENT OF REPORT.

The arrangement which has been adopted in the reports of previous years is followed in continuing this report, and the work charged to the construction account is kept separate from that charged to the maintenance account; but, as the work of construction and maintenance is supervised by the same principal engineers, and in very many cases the assistants are engaged upon both classes of work, it is not feasible to make a complete separation.

### CONSTRUCTION.

#### GENERAL STATEMENT.

The principal work of construction in progress during the year has been in connection with the repairs and reinforcement of the North Dike, the construction of ditches for the drainage of swamps on the Wachusett watershed in Holden and Princeton, the installation of electric lighting, pumping and hoisting machinery at the Wachusett Dam, the final cleaning of the bottom of the Wachusett Reservoir between elevation 375 and high-water mark, the completion of the Arlington pumping station, including the installing of pumping engines, boilers and piping, and the installation of an additional boiler at the high-service pumping station at Chestnut Hill.

A detailed statement of the contracts made and pending during the year is given in Appendix No. 1. The following statement gives a summary of all the contracts charged to construction from the beginning of the work to the end of the year 1907: —

PORTION OF WORK.	Number of Contracts.	Approximate Amount.
Wachusett Reservoir, . . . . .	38	\$3,057,395 87
Wachusett Dam, . . . . .	17	1,845,221 91
Relocation Central Massachusetts Railroad, . . .	6	516,327 67
Wachusett Aqueduct and Clinton sewerage, . . .	19	1,516,259 67
Sudbury Reservoir, the portions of contracts not performed at the time they were assumed from the city of Boston, . . . . .	11	583,220 54
Sudbury Department, reservoir, filter-beds, pipe lines and improvement of Lake Cochituate, Metropolitan Water Works contracts, . . . . .	22	956,508 17
Weston Aqueduct and Reservoir, . . . . .	26	2,212,403 31
Distribution Department, including pipes, valves, and special castings purchased for other departments, .	165	4,579,252 75
	304	\$15,266,589 89

Amount of 2 contracts made in 1907 (approximate), . . . . .	\$11,934 00
Amount of 2 contracts unfinished December 31, 1907 (approximate), . . . . .	15,240 00
Value of work done by contract from January 1, 1907, to December 31, 1907, . . . . .	50,585 96

## WACHUSETT RESERVOIR AND DAM.

### *North Dike.*

On the afternoon of April 11 an earth slide occurred at the North Dike of the Wachusett Reservoir, at which time 60,800 cubic yards of material from a section of the dike about 700 feet long slid into the reservoir. The slide occurred at the highest portion of the dike, where the artificial embankment was about 80 feet high and 1,930 feet thick at the base. The depth of the water in the reservoir in front of the embankment at the time of the slide was about 42 feet.

The dike, at the point where the slide occurred, had been constructed with a water-tight core 100 feet wide, the nearer edge of which was located about 50 feet back of high-water line. This core was composed of soil stripped from the reservoir, deposited in 6-inch layers and rolled, and was protected on the reservoir side by an embankment of sand and gravel. The embankment was faced with heavy riprap, stones screened from gravel, and coarse gravel; the heavy riprap extending from 5 feet above to 12 feet below high-water mark, the stones from the foot of the riprap for a further depth of about 12 feet, and the coarse gravel below to the foot of the slope. The



material used in the portion of the embankment between the water-tight core and the reservoir contained a large proportion of very fine sand which was excavated from the cut-off trench. This material was not consolidated when deposited in the embankment, and appearances indicate that when saturated by the rising water in the reservoir it would not stand on a slope of 2 horizontal to 1 vertical, which was the slope upon which the face of the embankment was constructed.

When the slide occurred the heavy stone riprap, which was about 10 feet in thickness, was carried from 150 to 250 feet by the momentum of the moving mass, and some of the sand and gravel was carried to a distance of 325 feet from the foot of the embankment.

Immediately after the slide occurred investigations were begun to determine the probable cause of the slide and the best method of making repairs to prevent further trouble. After obtaining the advice of the consulting engineers it was decided not only to repair the damage done by the slide, but also to reinforce the dike at this and other points.

The work as carried out consisted in reinforcing the dike wherever the artificial embankment extended below the foot of the riprap. This condition existed not only for a distance of about 1,000 feet, where the slide took place, but also at five points on the westerly portion of the dike, aggregating 1,560 feet. The embankment was reinforced by flattening the slope below the foot of the riprap from a slope of about 2 horizontal to 1 vertical, with which it was originally built, to a slope of 4 to 1, and at some points the slope was made 5 to 1. As it was not convenient to deposit the filling on this slope below the level of the water in the reservoir, a berm 30 feet wide was constructed about 2 feet above the water, and the filling allowed to take its natural slope, which was about 2 horizontal to 1 vertical. It is expected that the action of the waves will in time flatten this outer slope so that it will assume an approximately uniform slope of 4 to 1.

At the point near the centre of the slide, where the water in front of the embankment had been deepest, the berm was carried out for an additional width of 25 feet.

Above elevation 384 the embankment has been restored with practically the original section. Over the gravel slopes between elevations 375 and 400 there has been placed a layer of quarry chips 12



inches in thickness, and above elevation 384 the slope has been further protected by heavy riprap. There has also been placed at the toe of the heavy riprap, for an aggregate length of 6,500 feet, a section of quarry chips or field cobble stones 2 feet high at the foot of the riprap and having a slope of about 4 horizontal to 1 vertical. This was done for the purpose of preventing the washing out of the gravel from under the riprap by the action of the waves. With the exception of the placing of the heavy riprap all of this work has been done by a day-labor force under the immediate direction of the Superintendent of the Wachusett Department.

On April 29 a force of 50 men and 20 horses and carts began refilling the space made by the slide with gravel obtained near by, within the limits of the reservoir. The gravel was first deposited so as to restore and reinforce the embankment to a height about 2 feet above the level of the water in the reservoir, or to elevation 375, and was thoroughly consolidated by being deposited in the water, and also by the constant travel of the carts.

After this portion of the work was completed, the embankment, having a slope of 4 horizontal to 1 vertical, was constructed to elevation 383, and above this elevation practically the original section of the dike was replaced.

In placing the gravel above elevation 375 it was deposited in about 12-inch layers, and was consolidated by the traffic of the carts and by being saturated with water pumped upon it from the reservoir by means of a 6-inch by 4-inch by 6-inch Worthington duplex steam pump, which was kept in operation both day and night for about one month until the embankment reached elevation 400, or 5 feet above the level of the full reservoir.

Especial care was taken to excavate from the face of the slide all loose or cracked portions of the embankment, and jets of water were forced into the fill along the line between the new and old work for the purpose of securing a complete bond of the materials.

The day-labor work was completed on October 30. The maximum force employed was 137 men and 105 horses, and the average force was 114 men and 69 horses.

The quantities of materials handled and the cost of the work done by day labor, including the cost of building construction roads, pumping water for puddling embankment and of supplies and miscellaneous expenses, were as follows:—

	Cubic Yards.	Cost per Cubic Yard.	Total Cost.
Earth excavation:—			
Bank gravel, . . . . .	105,870	\$0.3295	\$34,895 04
Sand or fine gravel, . . . . .	6,118	0.2605	1,593 61
Loam, . . . . .	2,080	0.2920	607 31
Rock excavation:—			
Quarry chips, . . . . .	5,469	1.094	5,981 33
Field cobbles, . . . . .	1,026	0.577	591 80
Totals, . . . . .	129,563	—	\$43,669 09

On September 6 a contract was made with the Hugh Nawn Contracting Company of Boston to place about 7,000 cubic yards of riprap on the reservoir side of the repaired portion of the dike. The work of installing the plant was begun on September 24, placing of the riprap on October 17, and on December 31 only about 600 cubic yards remained to be placed.

The rock was secured from a quarry on land belonging to the Commonwealth, lying between the Wachusett Reservoir and the Central Massachusetts Railroad, about 900 feet west of the Wachusett Dam. At the quarry the rock was placed in skips, which were placed on flat cars and hauled about 2,800 feet by a small locomotive, and finally placed by means of a derrick. The maximum force employed was 49 men, during the week ending November 23, and the average force was 33 men. The cost of the work done under this contract to the close of the year was \$12,880. The total cost of the completed work will be about \$58,000.

### *Soil Stripping.*

On the southerly shore of the Wachusett Reservoir near Sawyer's Mills, near Boylston Center, near Pine Hill and near the West Boylston depot, and on the northerly shore near Sawyer's Mills and French Hill, additional clearing, grubbing and removal of soil have been done back of places where the steep banks, acted upon by the rising water, frost and rain, have caved away and retreated nearly to the limit of the original soil stripping, or of the additional soil stripping done last year. The soil has been stripped along an aggregate length of about 4,600 feet of shore line for a width of from 10 to 40 feet, the aggregate area being 2.1 acres.

*Cleaning of the Reservoir Bottom.*

Between September 1 and December 3 the final cleaning of the reservoir bottom was done between elevation 375 and the limits of stripping, or 3 feet above high water. Over the area between elevations 375 and 385 the greater part of the ground was harrowed with spring-tooth harrows, and the weeds, grass and bushes, together with the roots, were afterwards raked and burned; while over the remaining portion of this area, where the harrows could not be used on account of the ground being rocky, steep or wet, the weeds, grass and bushes were mowed close to the ground, and afterwards raked and burned. There was cleaned in this manner a total of 785 acres of ground, at a cost of \$5,426, or an average cost of \$6.91 per acre. This cost per acre is \$1.04 less than that of last year, notwithstanding the higher rates of wages paid, due to the fact that the entire area was cleaned last year in a similar manner. At the time this portion of the work was finished the waters in the reservoir were rising rapidly, and it was decided to continue the cleaning to the limits of stripping. So long as the weather conditions were favorable the methods pursued were as described above, but after freezing set in the weeds, grass and bushes were mowed close to the ground, the ground was thoroughly raked over with heavy iron road rakes and the débris was burned or removed from within the reservoir limits. The area treated in this manner was 345 acres, at a cost of \$2,129, making the average cost \$6.17 per acre. The entire area cleaned during the year was 1,130 acres, at a cost of \$7,555, or \$6.68 per acre.

*Shore Protection.*

On the northwesterly shore of the reservoir, just above the northwesterly end of the waste-weir of the dam, the slope of the ground for a distance of 165 feet being steeper than the natural slope of the material was protected with a covering of bank gravel during 1906, and in order to further protect this stretch of shore from the wave action to which it is exposed, riprap, having a thickness of about 3 feet, has been placed outside the gravel.

*Work at Wachusett Dam.*

A lighting, pumping and hoisting plant for use at the dam, and operated by water power, was installed between January 22 and April 3. The machinery consists of a 9-inch turbine, directly connected with a 22½-kilowatt generator, which are used in operating a 10 horse-power motor attached to a 6-inch submerged centrifugal pump, and a 6 horse-power motor connected with a crane for handling stop-planks and screens in the upper gate-chamber. The turbine was furnished and installed by the Holyoke Machine Company of Worcester; the generator and motors were built by the Stanley Electric Company, furnished by the Frank Ridlon Company, and installed by the Plummer Electric Company, who also did all the wiring, etc., necessary for the complete installation of the plant.

Aside from the skilled labor furnished by the Holyoke Machine Company and the Plummer Electric Company, the work was done by the regular maintenance force.

In addition to and in connection with the above work a concrete floor has been built in the exciter room, and the wooden floor of the main room has been raised to its permanent level.

A 4-inch Venturi meter has been set and connected with a manometer tube for measuring and recording such quantities of water furnished the Lancaster Mills as are too small to be measured through the 12-inch Venturi meter.

The 10-inch Venturi meter which measures the water flowing into the Lancaster Mills Pond has been fitted with a manometer tube for indicating the flow.

Two iron ladders, made by the New England Bolt and Steel Company, one 29 feet 2 inches long and the other 18 feet ½ inch long, have been placed in the drain well and well No. 4 of the lower gate-chamber.

For the purpose of preventing percolation of water through the masonry of the dam, expansion cracks in the joints of the ashlar facing of the up-stream face of the dam were filled and painted with Portland cement mortar, between elevations 367.50 and 380, during very cold weather in February, when the cracks were the largest, and continued to elevation 384 in November, in order to keep the work above the rapidly rising waters in the reservoir.

*Miscellaneous.*

During the year 49 acres of land about the margins of the Wachusett Reservoir in the town of West Boylston has been graded and seeded. About 35 acres of this land was a shallow flowage fill in Oakdale, and on the remainder there were old cellar holes which required considerable grading. At the gravel pit in Clinton, from which sand and gravel were obtained for use in constructing the Wachusett Dam, such grading has been done as was necessary to smooth the slopes and fill depressions so as to prepare the ground for the planting of pine trees.

The houses on the properties formerly owned by Aime Gregoire and Delia A. DeFoe in Boylston, and by Henry O. Sawyer in West Boylston, have been demolished.

## IMPROVEMENT OF WACHUSETT WATERSHED.

*Drainage of Swamps.*

The construction of ditches for the drainage of swamps tributary to the Wachusett Reservoir, which was suspended on December 1, 1906, was resumed on May 22, 1907, in the swamp on Governor Brook, above the junction of Trout and Governor brooks in the towns of Holden and Princeton.

The methods of carrying on the work, types of ditches built and permits received from the owners of the land have been substantially the same as described in the annual reports of January 1, 1899, and January 1, 1907.

The swamp on Governor Brook has an area of 220 acres, which includes 4 acres of what was previously considered a separate swamp, but which is virtually a part of this one, and the area of the watershed above its outlet is about 1,625 acres. Work in this swamp was completed on November 23.

The depth of the ditches constructed is generally  $1\frac{1}{2}$  to 3 feet, and the slope paving is carried to a height of 1 to 2 feet above the bottom. In connection with this work a stone highway culvert  $4\frac{1}{2}$  feet wide by  $4\frac{1}{2}$  feet high was built across an abandoned but not discontinued highway, about 1,000 feet east of the highway leading from Quinepoxet to East Princeton. The old culvert at this highway was too high for the grade of the new ditch and insufficient in capacity. The work has been done by a day-labor force.



The maximum force employed was 46 men and 4 horses during the week ending August 24, and the average force was 35 men and 1 horse.

The amount of work done during the year was as follows:—

Ditches with board bottom and paving on sides (linear feet), . . . .	19,864
Ditches with stone paving on bottom and sides (linear feet), . . . .	335
Ditches without board bottom or paving (linear feet), . . . .	2,865
<hr/>	
Total length of ditches (linear feet), . . . . .	23,064
Farm crossings, . . . . .	12
Watering places, . . . . .	2
4½-foot by 4½-foot stone highway culvert, . . . . .	1
Wire guard fences (linear feet), . . . . .	2,025

The total amount of work done in this swamp, including the work done in 1906, was as follows:—

Ditches with board bottom and paving on sides (linear feet), . . . .	23,959
Ditches with stone paving on bottom and sides (linear feet), . . . .	447
Ditches without board bottom or paving (linear feet), . . . .	3,255
<hr/>	
Total length of ditches (linear feet), . . . . .	27,661
Brook improved (linear feet), . . . . .	120
Farm crossings, . . . . .	17
Watering places, . . . . .	5
2-foot by 2-foot concrete highway culvert, . . . . .	1
4½-foot by 4½ foot stone highway culvert, . . . . .	1
Wire guard fences (linear feet), . . . . .	2,025

The total length of ditches constructed during the year was 23,064 feet, equal to 4.37 miles, at a cost, exclusive of engineering, of \$10,647, or \$0.462 per foot. This cost is slightly lower than last year, although higher rates of wages were paid, and the cost of cleaning up on both sides of the ditches built both last year and this, is included. This result may be attributed largely to having a foreman and laborers who were experienced in this line of work, and also to the dry condition of the swamp, due to the small rainfall during the greater part of the working season. The cost of the work includes the cost of building the culvert, farm crossings, watering places and wire guard fences.

Since November 23, 1899, when the drainage of swamps in the Wachusett watershed was commenced, there have been constructed 57,812 linear feet of ditches, equal to 10.95 miles.



*Sterling Filter-beds.*

Work under A. McKenzie & Company's contract for the construction of four filter-beds, to be used for filtering the water of a small brook, which has its head waters in the village of Sterling Center, was resumed on April 1 and completed on May 23, 1907.

The location, description and proposed method of operating this plant were fully described in last year's report.

The following table gives the quantities of work done to December 31, 1906, during 1907, and the total amount of work done to the end of the contract, based on the final estimate:—

	To Decem- ber 31, 1906.	During 1907.	Total.
Earth excavation (cubic yards), . . . . .	25,270	3,642	28,912
Concrete masonry (cubic yards), . . . . .	41	15.6	56.6
Dry rubble-stone masonry and paving (cubic yards), . .	166	69	235
18-inch vitrified pipe (linear feet), . . . . .	132	6.7	138.7
15-inch vitrified pipe (linear feet), . . . . .	269.4	0	269.4
12-inch vitrified pipe (linear feet), . . . . .	145	312.4	457.4
8-inch vitrified pipe (linear feet), . . . . .	856.5	0	856.5
6-inch vitrified pipe (linear feet), . . . . .	880	38.0	918.0

In addition to the above work the contractors built about 1,960 feet of wire truss fencing on the property lines; built a concrete watering trough 3 feet wide by 7 feet long by 2 feet deep for William Kingsbury's cattle, and laid 55 feet of 1-inch water pipe from the main inlet ditch to the trough.

The maximum force employed by the contractor was 29 men and 7 horses, during the week ending April 20, and the average force was 22 men and 4 horses.

During the extremely dry season last summer it was found that the small amount of water coming from the ditches above the filter-beds seeped through the paving in the bottom of the inlet ditch before it reached the inlet to Kingsbury's watering trough, so, in order to utilize what water there was in the ditch, the joints in the bottom of the paving were filled with Portland cement mortar from the end of the board bottom swamp drainage ditch to the inlet pipe to the trough, a distance of 380 feet.

A small wooden building 8 feet by 12 feet has been built for the storage of tools and convenience of the keeper.

The water flowing in the brook was turned on to the beds on May 23, and the entire flow of the brook has been filtered since that date.

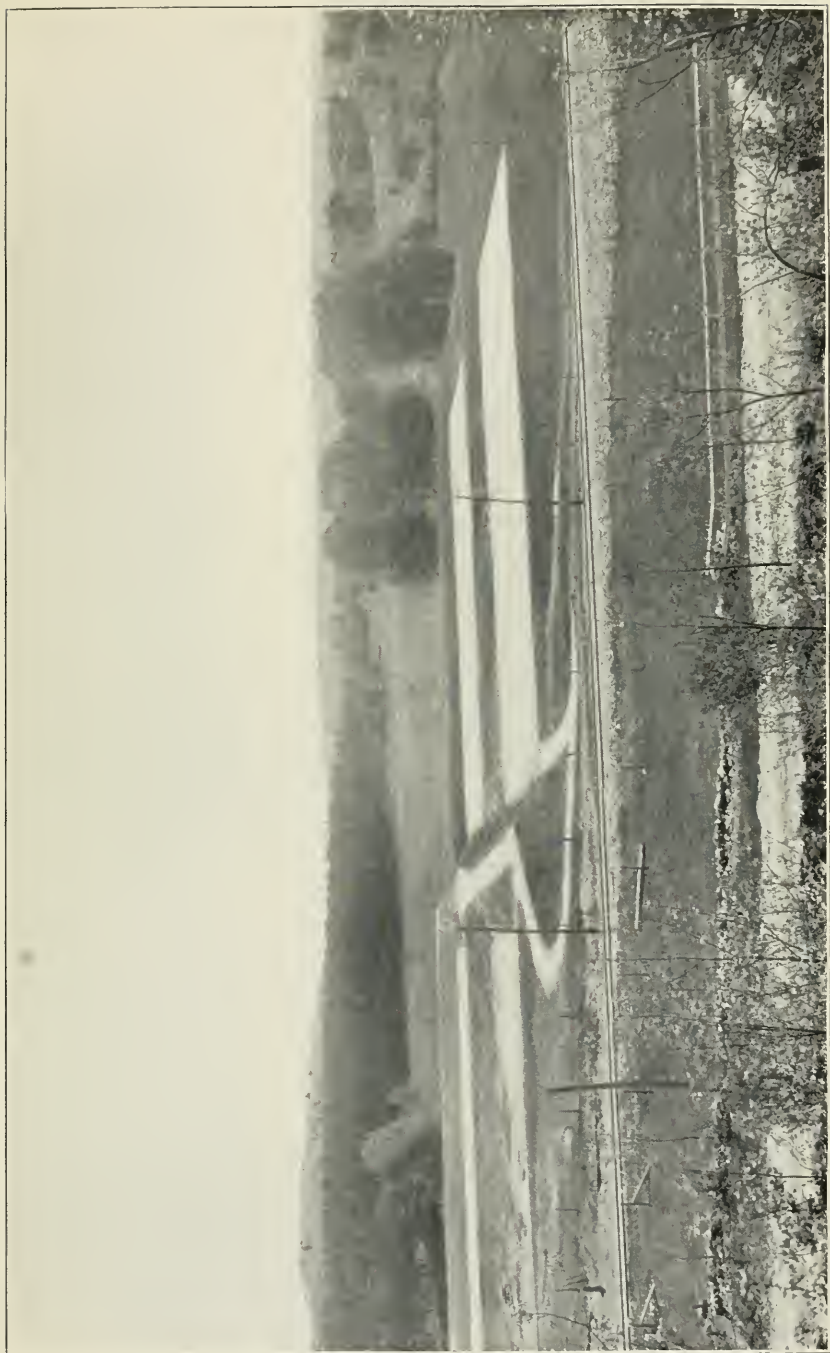
### *Sterling Junction Filter-beds.*

Immediately north of the main highway leading through the Methodist Camp Grounds at Sterling Junction there are 4 cottages and 1 summer boarding-house, from which the sewage was conducted by a covered drain into a cesspool about 400 feet from the south shore of Middle Waushacum Pond. As the drain also received surface water the cesspool overflowed after heavy rains, and its contents discharged into the running water, which eventually found its way into the pond. To eliminate this nuisance four small filter-beds, each having an area of 300 square feet, were built near the site of the old cesspool. The material at the site was not suitable for filtration, and it was necessary to excavate the entire filtering prism of each bed and refill it to a depth of 5 feet with selected filtering material. All soil and material excavated from the beds were used in making the embankments.

An 8-inch vitrified pipe drain 87 feet long connects the old drain with a concrete regulating chamber which is provided with stop-planks, arranged in such a manner that water can be turned on to any one of the four beds or any combination of them, and, when the beds become filled, the water cannot rise higher than within a safe distance of the top of the embankments, as it will then overflow into an 8-inch vitrified pipe drain which discharges into an open ditch below the beds. It was not deemed necessary to provide for filtering all the water during heavy rainfalls, and this overflow will take care of all water exceeding the capacity of the beds, which is ample during average conditions. It will not be necessary to operate the beds during the winter as the houses are not then occupied. Through the centre and 5 feet below the surface of each bed a 4-inch vitrified pipe underdrain is laid, parallel with the main feeder. These underdrains empty into the open ditch at the same point as the 8-inch overflow drain. The above work was done by day-labor forces.

This plant was first put into operation on September 16, and has been in continual use ever since.

The work was begun on August 26 and finished on September 21, at a total cost of \$541.13.



FILTER BEDS IN STERLING ON WACHUSETT WATERSHED.



*Miscellaneous Work.*

For the purpose of preventing objectionable drainage from entering the brooks running into the Wachusett Reservoir, 3 cesspools and 1 cemented vault have been constructed to take care of barn, sink and privy drainage in the town of Sterling.

On the Quinepoxet River, immediately above the circular dam at the head waters of the Wachusett Reservoir, the intervale land, which is very low, and is covered with a stand of heavy timber, is flooded in times of heavy flows. All the dead wood, brush, undesirable trees, etc., were cut and burned over an area of 14 acres extending upstream about 4,000 feet, to prevent the same from being washed into the reservoir.

At Dorr's Mill, on the Quinepoxet River, about 1½ miles above Oakdale, the stone walls of the mill have been razed, the cellar holes of the mill and tenement houses given a general cleaning up, and the head of the canal has been permanently closed by rock and gravel filling.

At Warfield's Mill all the apple trees have been cut into logs and cord wood and the cellar holes have been cleaned up.

At the Gates farm, on the south shore of Middle Waushacum Pond in Sterling, the old farmhouse and barns and five summer cottages have been destroyed, and wire guard fences have been built to keep within reasonable limits patrons of the steamer on the lake. On the boundary line adjoining property of the heirs of Andrew L. Fitch, 1,230 feet of wire fencing has been built along the top of an old stone wall, to keep cattle from trespassing. This was about one-half the total length of the line, repairs on the other half being made by the occupants of the Fitch farm.

## ARLINGTON PUMPING STATION.

During the past year the pumping station building, which was partially constructed in 1906, has been completed, an engine and boilers have been installed, and a second engine is now being erected.

C. A. Dodge & Co., the contractor for the building, chimney and engine foundations, had at the beginning of the year completed about half of the work to be done under the contract. Masonry work was continued during the winter, whenever the weather was favorable, the roof trusses were erected early in March, and the contract was finished on July 19.



The Allis-Chalmers Company delivered the parts of the engine at the station during the latter part of July, and the engine was placed in regular service on December 4.

A contract for two boilers and a smoke flue for this station was made on January 30 with the Hodge Boiler Works of East Boston. The boilers and flue were delivered during September. The boilers have been set, the suction and delivery piping connected with the engine, the feed piping for the boilers and the heating and other miscellaneous small piping connected with the plant have been erected, and the grounds about the building graded by the maintenance force. A side track for the delivery of coal, built by the Boston & Maine Railroad, was completed and put in service on May 10.

On April 3 a contract was made with the Blake & Knowles Steam Pump Works for the delivery and erection of a compound, duplex, direct-acting pumping engine, having a capacity of 1,500,000 gallons per day. This engine was tested at the shop of the builder on December 23, and will be placed in position at the station in readiness for use early in the coming year.

The following is a description of the building and machinery. The main building is 90 feet by 46 feet on the outside, and it is about 26 feet from the ground to the cornice. The foundation walls are of Portland cement concrete, faced, where exposed on the outside below the water-table course, with seam-faced granite. The exterior walls are of dark-red faced brick, with Long Meadow brown-stone trimmings, and are surmounted by a hip roof supported by steel trusses and covered with slate. The steps at the main entrance, the water-table course and the trimmings below the water-table are of pink Milford granite. The building is subdivided by a division wall forming an engine room 48 feet long by 40 feet wide and 24 feet high, and a boiler room 40 feet long by 35 feet wide and 33 feet high. In the rear of the boiler room there is an underground coal pocket 33 feet long by 27 feet wide by 10 feet high, covered by a reinforced concrete roof over which the side track is carried. In this roof there are 16 openings through which coal may be unloaded from the cars. The brick chimney is in the rear of the building. It is 70 feet high and 8 feet in diameter at the base, diminishing to 5 feet in diameter at a point 6 feet below the top. The flue is 2 feet 6 inches in diameter. The main entrance is on the front of the building. The



vestibule is 7 feet by 9 feet, and on either side of it are the office and toilet room, both 8 feet by 9 feet, the three forming a projection from the main building 10 feet by 29 feet.

The interior facing of the engine and boiler room walls is of red brick. The engine room floor is of red quarry tile. The floors in the basement of the engine room and in the boiler and coal houses are granolithic.

The engine furnished by the Allis-Chalmers Company is a horizontal, cross-compound, fly-wheel engine fitted with Corliss valve gear, and operating two horizontal, outside packed, plunger pumps. The high and low pressure steam pistons are 14 inches and 28 inches in diameter, respectively, and the pump plungers  $8\frac{1}{2}$  inches in diameter, all having a stroke of 18 inches. The capacity of the engine at 65 revolutions per minute is 1,500,000 gallons in twenty-four hours.

The engine which is being erected by the Blake & Knowles Steam Pump Works is of the horizontal, cross-compound, direct-acting type, operating two outside packed, plunger pumps. The steam cylinders are 11 inches and 22 inches in diameter, the pump plungers 12 inches in diameter, and both pistons and plungers have a stroke of 18 inches. When operated at the rate of 31 revolutions per minute the capacity is 1,500,000 gallons per day.

There are two boilers of the horizontal, under-fired type, each 54 inches in diameter, containing 60 3-inch tubes 17 feet long. The furnaces are fitted with the Foster shaking grates, 4 feet wide by  $5\frac{1}{2}$  feet long.

The principal items of cost of this station to December 31, exclusive of engineering, are as follows:—

Building, including chimney and engine and boiler foundations, . . . . .	\$31,655 62
Allis-Chalmers Company engine (unfinished), . . . . .	4,753 24
Boilers and setting, . . . . .	5,983 03
Piping for engines, boilers, heating, etc., . . . . .	2,198 09
Side track, . . . . .	721 23
Miscellaneous, including laying of suction and delivery pipes, grading grounds, fencing and other work, . . . . .	3,017 31
	<hr/>
	\$48,328 52

### ADDITIONAL BOILER AT THE CHESTNUT HILL HIGH-SERVICE STATION.

A contract for making and delivering at this station a 54-inch horizontal, tubular boiler, containing 102 3-inch tubes 18 feet long, was made with the Hodge Boiler Works of East Boston on January 30, in connection with a contract for the boilers at the Arlington station. This boiler was delivered on August 28, and has been set and connected by the maintenance force in readiness for use. It is of the same size and design as two boilers erected at the station in 1901, and has been set between these boilers, so that the three form a battery which will supply steam for the largest engine in the station without the use of other boilers. The cost of the boiler, with cast-iron front and smoke flue, delivered at the station, was \$2,976.

### ENGINEERING.

The engineering work, aside from that connected with the supervision of the contract and day-labor work in progress, has consisted principally of the following. The survey of the marginal line of the Wachusett watershed has been completed and the area of the watershed computed. The total length of the watershed line has been determined to be 78.93 miles, and the area of the watershed above the dam 118.19 square miles. Contour lines have been drawn on the final record sheets of the elevation of the bottom of the Wachusett Reservoir, covering an area of 323 acres, making a total of 4,123 acres covered by final record sheets on which the contour lines have been drawn, which completes this work except where the bottom of the reservoir has been changed because of the slide and repairs at the North Dike, and the caving of the shores at several points. The computing of the final capacity of the Wachusett Reservoir has been completed and tabulated, subject to slight revision when the caving of the steep slopes ceases. Record plans showing the contours of the bottom of the reservoir, the marginal lands, with highways, brooks, buildings, etc., have been largely completed. A general location and record plan of the Wachusett Reservoir has been made, showing property owned by the Board. Considerable progress has been made in making record plans of the Wachusett Aqueduct right of way.

A considerable portion of the time of the drafting force has been devoted to the completion of record plans of the Wachusett Dam,

Weston Reservoir and the Clinton Sewerage Works. Other work done by this force has been the preparation of plans for boilers and setting at the Arlington and Chestnut Hill stations, for floor plates and piping at the Arlington station, and studies for design for floor of the lower gate-chamber at the Wachusett Dam.

## MAINTENANCE.

### RAINFALL AND YIELD.

The total rainfall for the year on the Sudbury watershed has been 44.38 inches, or 1.61 inches below the average for thirty-three years. On the Wachusett watershed the total rainfall has been 45.74 inches, or 3.25 inches below the average for the past eleven years, during which the records have been kept. On both of these watersheds the yield during the first six months of the year was much below the average, that of the Wachusett watershed for the period being 1,170,000 gallons per square mile per day, which is 30 per cent. below the average for the past eleven years, and less than any previous record for this watershed. During the last four months of the year, however, the rainfall and yield were larger than usual, and for the whole year the yield of both the Sudbury and Wachusett watersheds is but little below the average.

Statistics relating to rainfall and yield of watersheds may be found in Appendix No. 3, tables Nos. 1 to 11.

### STORAGE RESERVOIRS.

The quantity of water stored in all of the storage reservoirs on January 1, 1907, was 44,153,200,000 gallons. During the month of January there was an increase of a little less than 2,600,000,000 gallons in the quantity stored, but during February, and until March 14, there was a loss in storage amounting to 2,000,000,000 gallons. There was a gain of 4,800,000,000 gallons during the latter half of March, 3,000,000,000 gallons in April, 900,000,000 gallons in May, and on June 11 the total was 54,369,400,000 gallons. From this date until September 23 there was an almost continual reduction in the quantity of water stored, the total loss being 8,840,000,000 gallons. As a result of rainfalls amounting to about 25 inches during the last four months of the year, the gain in storage from September 23 to January 1, 1908, was approximately 20,000,000,000 gallons.

and the maximum of storage for the year was reached on December 31.

The following table gives the quantity of water stored in the storage reservoirs at the beginning of each month:—

*Quantity of Water stored in Wachusett Reservoir, and in Reservoirs on Sudbury and Cochituate Watersheds, at the Beginning of Each Month.*

DATE.	In Wachusett Reservoir (Gallons).	In Sudbury Reservoir and Framingham Reservoir No. 3 (Gallons).	In All Other Storage Reservoirs (Gallons).	Total (Gallons).
<b>1907.</b>				
January 1, . . . . .	31,752,900,000	6,748,900,000	5,651,400,000	44,153,200,000
February 1, . . . . .	34,071,500,000	6,536,600,000	6,143,800,000	46,751,900,000
March 1, . . . . .	33,416,800,000	6,177,900,000	5,705,000,000	45,299,700,000
April 1, . . . . .	36,703,600,000	6,336,000,000	6,462,400,000	49,502,000,000
May 1, . . . . .	38,580,300,000	7,032,600,000	6,967,000,000	52,579,900,000
June 1, . . . . .	38,300,700,000	7,878,300,000	7,292,700,000	53,471,700,000
July 1, . . . . .	38,664,500,000	7,841,500,000	7,122,300,000	53,628,300,000
August 1, . . . . .	36,875,400,000	7,856,500,000	6,212,500,000	50,944,400,000
September 1, . . . . .	34,741,600,000	7,968,200,000	4,358,700,000	47,068,500,000
October 1, . . . . .	35,480,400,000	8,037,000,000	3,489,400,000	47,006,800,000
November 1, . . . . .	38,772,600,000	7,437,600,000	3,854,300,000	50,064,500,000
December 1, . . . . .	46,110,300,000	7,937,100,000	5,216,200,000	59,263,600,000
<b>1908.</b>				
January 1, . . . . .	51,267,000,000	7,947,300,000	6,645,200,000	65,859,500,000

*Wachusett Reservoir.*—At the beginning of the year the water in this reservoir was at elevation 364.57, and the reservoir contained 31,752,900,000 gallons. On account of the small yield of the watershed during the first half of the year, and on account of the draft for the supply of the Metropolitan District, the rise of the reservoir was small, and from January 1 to the middle of June the surface rose but 8.40 feet, to elevation 372.97. From June 19 to September 23 the reservoir surface fell 5.59 feet, and after the latter date until the end of the year there was an almost continuous and at times rapid rise, amounting to 16.93 feet, making the net rise for the year 19.74 feet, equivalent to a gain in storage of 19,514,100,000 gallons. The only water discharged from the reservoir into the river below the dam was that required for the use of the Lancaster Mills. The surface of the Lancaster Mills Pond was kept up to the crest of its dam until the middle of August, after which the water level was lowered about 1 foot, in order to prevent the water from splashing over the crest of the dam. The average quantity as measured at the Clinton gaging station below the Lancaster Mills was 3,884,000 gallons per day.

The 50-foot marginal strip along the full reservoir flow-line has

been kept mowed, and miscellaneous rubbish has been collected from time to time along the shore line of the reservoir and burned.

At nineteen points around the reservoir, where main highways and driveways were discontinued, barways or gates have been built for the protection of the public.

The heavy rains during the late summer washed out large gulleys in the banks of the reservoir at the Sawyer's Mills shallow-flowage fill on the north shore, near the entrance of Gates Brook on the south shore, and on the Stillwater River branch in Oakdale. To prevent this in the future paved gutters have been built, having an aggregate length of 220 feet.

The grass from 306 acres of land on the North and South dikes, and marginal lands in Sterling, Clinton, Boylston and West Boylston has been sold at auction for \$1,999.50, and from 93 acres on the outlying lands for \$273.00.

At the Wachusett Dam the maintenance work, consisting of the operation of the valves controlling the flow of water, the cleaning of screens, taking care of the gate-chambers and of the grounds above and below the dam has been done by three gate-keepers, assisted by from two to four laborers whenever necessary.

Since the works were completed the discharge of water from the reservoir into the lower gate-chamber was until October controlled by the use of 24-inch valves in the lower gate-chamber, which were operated under a pressure of about 35 pounds. This method of operation caused a vibration of the pipes, which not only made a continual objectionable noise, but also caused the pipes to work loose in their beds, the leaded joints to leak, and the 1½-inch diameter bolts, with which the flanges of the pipes are bolted together, to work loose, and in some cases to break off. It was found by experiment that by opening the sluice gates in the upper gate-chamber so as to discharge the exact quantity desired, and regulating the 24-inch valves in the lower gate-chamber so that they operated under a pressure of 13 pounds per square inch, the noise and vibration could be almost entirely eliminated. This method of operation has been used since October 15, with apparently entirely satisfactory results.

Both the exterior and interior woodwork of the upper and lower gate-chambers and of the chamber in the bastion were painted, also iron fences and other ironwork about the dam.

*Sudbury Reservoir.* — At the beginning of the year the water in



this reservoir stood at elevation 256.45, or 2.55 feet below the stone crest of the overflow. Until April 20 the water was kept from 3 to 4 feet below the stone crest, in order to provide storage in case of large yields from the watershed. From May 14 until October 11, and from November 7 to the end of the year, all water flowing from this reservoir into Framingham Reservoir No. 3 flowed over the crest of the Sudbury Dam. A longitudinal joint on the up-stream face of the dam, between 2 and 3 feet below the crest, also some vertical joints extending upwards toward the crest, were cut out and re-pointed. A blind drain was built around the foot of the southerly wingwall of the dam, where the ground had always been wet. A 4-strand twisted wire fence, 375 feet long, was built between land of the Commonwealth and Alonzo Newton.

New stairways have been built on the slopes of the embankment on either side of the overflow, constructed with hard-pine treads and cypress stringers supported by chestnut posts.

The interior iron and wood work in the gate-house and the roof of the house occupied by the foreman have been painted.

Work has been continued as opportunity offered on a service road around the northerly side of the reservoir.

The 14 acres of filter-beds, which are used in filtering the water of Marlborough Brook, were cleaned in June, and the beds were weeded in September and October. There was no overflow from the beds into the reservoir during the year.

There was but little flow of sewage into the small basin and filter-bed near Farm Road, which receives the overflow from the Marlborough main sewer during freshets, but there was a flow of ground water into the basin during the spring and fall. The filter-bed was cleaned.

*Framingham Reservoir No. 3.* — The elevation of the water in this reservoir is controlled by drafts from the Sudbury Reservoir, and during the greater portion of the year its surface was from 1½ to 3 feet below the stone crest of the overflow. After October 10 the reservoir was kept about 3 feet below the crest of the dam, in order to facilitate the work of widening and relocating Worcester Street. In order to enable the Boston & Worcester Street Railway Company to lay a double track, and at the same time to improve the grades and do away with numerous sharp curves, the width of Worcester Street between Framingham Centre and Southborough has been increased to 75 feet, and its location radically changed at



several points. The new location encroaches upon both Framingham reservoirs Nos. 1 and 3, and the necessary filling reduces the capacity of Reservoir No. 1 by 1,200,000 gallons, and of No. 3 by about 3,500,000 gallons. Where the street crosses Framingham Reservoir No. 1 the widening will necessitate the lengthening of the abutments and the rebuilding of the bridge over the reservoir. This portion of the work has not yet been commenced, but the filling into Reservoir No. 3 and the repaving of the slopes have been completed. All of the work is being done by and at the expense of the Boston & Worcester Street Railway Company, and the interest of the Metropolitan Water and Sewerage Board has been to see that the work was carried on in such a manner as not to injure the property of the Commonwealth. With this object in view a movable boom, from which was suspended a weighted canvas reaching to the bottom of the reservoir, was placed in front of the place where filling was being dumped into the reservoir, so as to prevent the roily water from being spread through the reservoir and carried into the aqueduct. A large portion of the material used for filling was a clayey hardpan, but where exposed to the water this was faced with 2 feet of clean gravel, on which was placed paving 12 inches to 18 inches in thickness, above the water level, for a vertical height of  $6\frac{1}{2}$  feet, and riprap of about the same thickness below the water to the foot of the slopes. The length of the slopes repaved on both sides of the roadway in Reservoir No. 3 was about 2,000 feet.

*Framingham Reservoir No. 2.* — This reservoir was full during the greater portion of the year. Water for the supply of the Metropolitan District was drawn from the reservoir from May 14 to October 12, and on a few days in October and November water was drawn from the reservoir to replenish Lake Cochituate. The woodwork of the floor of the Fountain Street bridge crossing this reservoir has been entirely renewed. The floor stringers were made of 4-inch by 14-inch hard pine, the bottom floor of 3-inch hard-pine plank and the top floor of 2-inch chestnut. All of the hard-pine stringers were treated with Conservo, for preservation. The stringers of this bridge had not been renewed since the bridge was built in 1879. A wire fence 625 feet long was built on the line of Fountain Street, near the head of the reservoir.

*Framingham Reservoir No. 1.* — This reservoir was substantially full throughout the year, except for short periods in October and November, when water was drawn from it to replenish Lake Cochit-

uate. In addition to the 1,500,000 gallons required to flow past the dam daily, water was wasted in every month of the year except during July, August and September. The barn at the Bullard place, used by the foreman in charge of the Framingham, Ashland and Hopkinton reservoirs, has been shingled and painted.

*Ashland Reservoir.* — This reservoir was full at the beginning of the year and water was wasted at the overflow for the greater portion of the time until July 23, when the reservoir was drawn upon for the supply of the Metropolitan District. During the following two months the reservoir fell rapidly, and on September 29, when the outlet gates were closed, the reservoir surface was 25.75 feet below high water. During October, November and December the reservoir was constantly rising, and on January 1, 1908, was 4.73 feet below high water.

*Hopkinton Reservoir.* — At the beginning of the year the water in this reservoir was at elevation 303, or 2 feet below high water, but on January 2 water was wasting over the waste-weir, and continued to waste until the early part of February, when the reservoir was lowered about 11½ feet. In April it was allowed to rise and flow over the waste-weir, and in May over the flash-boards. A draft for the supply of the Metropolitan District was started on July 11, and the water fell rapidly until September 29, when the outlet gate was closed, the reservoir surface being then 24.95 feet below high water. On January 1, 1908, the reservoir had refilled to elevation 300.66, or 4.34 feet below high-water mark. The barn used by the attendant was shingled, and the filter-beds below the dam were twice cleaned during the year.

*Whitehall Reservoir.* — This reservoir was kept near high-water mark except during the early spring. No water was drawn from the reservoir for the supply of the Metropolitan District. More attention than heretofore has been given to the regulation of boating and to the enforcement of sanitary regulations, resulting in improved conditions. There are now 27 cottages around the reservoir occupied by summer residents, and about 77 boats of different kinds upon the reservoir.

*Farm Pond.* — As the town of Framingham has drawn a portion of its supply directly from the Sudbury Aqueduct instead of from the filter gallery alongside the pond it has not been found necessary to replenish the pond during the year from the Framingham reservoirs, as has been customary in the past. The elevation of the

pond has ranged between high-water mark and  $11\frac{1}{2}$  feet below that point.

*Lake Cochituate.* — The water in the lake at the beginning of the year was 5.8 feet below high water. Although the rise of the lake was retarded by a flow into the Cochituate Aqueduct from February 12 to April 9, it reached high water on April 16, when water was permitted to waste at the outlet dam. The waste was continued until June 12, when a flow in the Cochituate Aqueduct from that date to the 24th prevented the necessity of further waste. The flow in the Cochituate Aqueduct was again started on July 12, and the water in the lake fell to 7.2 feet below high water on September 28, after which date, aided by heavy rains and a supply of water from Framingham reservoirs Nos. 1 and 2, the lake rose to within 0.09 of a foot of high water at the end of the year. The flow started in the Cochituate Aqueduct on July 12 was maintained without interruption to December 6.

During the year considerable repair work was done at the house occupied by the foreman and the barn was shingled. The hard-pine floor of the walk crossing the overflow at the outlet dam was renewed, and the bridge crossing the stream below the dam was rebuilt with the best of the timber taken from the Fountain Street bridge at Ashland. Both the exterior and interior wood and iron work of the effluent gate-house were painted, also the ironwork at the outlet dam. Two hundred and fifty stone bounds, 4 feet 6 inches long, were cut, by contract, from stones removed from the old outlet dam. The stone property bounds which were originally set around the lake were small, and only about 18 inches in length, of which 5 or 6 inches was set above the level of the ground. As a result many of the bounds have been thrown out of position by the frost, or pulled up and lost, so that it is often difficult to determine the exact location of the property lines. During the past year 13 bounds, 4 feet 6 inches long, were set at points where there were no bounds, and there are now 75 points where no bounds are set and about 300 points where the short bounds should be replaced by longer bounds of our present standard. This work it is proposed to do during the coming year. During the fall and early winter, while the water was low in the lake, all rubbish on the shores and a large quantity of leaves which had collected in the coves were removed. The widening of the road-bed of the Boston & Albany Railroad, so as to accommodate four tracks, necessitated the lengthening of the stone arch

culvert over the Beaver Dam Brook arm of the lake, also some filling into the lake at other points. Care was taken to see that suitable materials were used for this purpose, and a careful sanitary inspection was maintained, not only at the crossing of the lake but also wherever there was possibility of pollution of the tributaries of the lake.

The registration of boats used on the lake, which was inaugurated in 1906, was continued with satisfactory results. One hundred and seventy-six applications for registration were received and 142 were granted. The season was extended from September 20 to October 15, but only a few of the cottagers remained to the end of the season. Four new cottages were built and 1 burned, making the number at the end of the year 59.

No water has been turned from Dudley Pond into Lake Cochituate, and the elevation of the pond has ranged between 3.81 and 2.56 feet below high water during the year. There are 18 summer cottages on the shore of the pond.

The surface of Dug Pond has varied between 0.48 of a foot above and 2.27 feet below the invert of the 18-inch overflow pipe.

Water was pumped on to the Pegan Brook filter-beds on 228 days during the year. The total quantity pumped was 305,859,000 gallons, of which 266,000,000 gallons were from Pegan Brook and 98,859,000 gallons from the intercepting ditch which collects water from the brooks formerly draining into Pegan Brook Meadow. The total quantity of coal consumed was 196,705 pounds, so that 1,555 gallons of water were pumped per pound of coal. The cost of operating the pumping station, cleaning the filter-beds and caring for the grounds was \$2,841.14, making the cost per million gallons \$9.29. The filter-beds have been cleaned and the ditches in the upper part of the receiving reservoir were cleaned twice during the year. The intercepting ditch on the east side of Pegan Meadow was cleaned in the fall. The widening of the road-bed of the Boston & Albany Railroad, to accommodate two additional tracks, has decreased somewhat the storage capacity of filter-bed No. 6.

#### SOURCES FROM WHICH WATER HAS BEEN TAKEN.

An average of 82,589,000 gallons of water per day was drawn from the Wachusett Reservoir through the Wachusett Aqueduct into the Sudbury Reservoir. An average of 30,350,000 gallons per day was drawn from the Sudbury Reservoir through the Weston Aque-

duct into the distribution system of the Metropolitan Water District. From Framingham Reservoir No. 3 an average of 72,929,000 gallons per day and from Framingham Reservoir No. 2 an average of 11,726,000 gallons per day was drawn through the Sudbury Aqueduct to Chestnut Hill Reservoir. An average of 11,398,000 gallons per day was drawn from Lake Cochituate through the Cochituate Aqueduct to Chestnut Hill Reservoir. The Spot Pond drainage area furnished 418,000 gallons per day.

#### AQUEDUCTS.

The *Wachusett Aqueduct* has been in use on the whole or a portion of 333 days during the year. The usual annual cleaning of the aqueduct has been deferred until some convenient time in the early part of next year. During the early summer 2,751 feet of galvanized ribbon wire fencing was built along the westerly side of the aqueduct land in the town of Northborough, between Pierce's bridge and the crossing of the New York, New Haven & Hartford Railroad, to prevent cattle pastured on adjacent land from trespassing on the embankment.

A new flight of chestnut steps, 53 feet long, has been placed on the slope of the aqueduct embankment at the westerly end of the Assabet Bridge in Northborough.

The usual work of cutting brush and weeds, cleaning out culverts and berm ditches, and general repairs along the aqueduct and open channel has been done. All fruit trees on the aqueduct land have been cut and worked up into cordwood. The fences and other iron-work at the terminus of the aqueduct in Southborough have been painted.

The *Sudbury Aqueduct* was in use on 357 days of the year for conveying water from reservoirs Nos. 2 and 3 to Chestnut Hill Reservoir, and on 7 days for conveying water from reservoirs Nos. 1 and 2 to Lake Cochituate. The flow was interrupted for a few hours on each of 2 days for the purpose of examining a sluice gate at Framingham Dam No. 1, and for the purpose of repairing the screen grooves at the Farm Pond gate-house, and also on 4 other days when changing the direction of the flow from into Chestnut Hill Reservoir to Lake Cochituate, or the reverse.

The joints in the masonry of culvert No. 6, at station 83+75, in Sherborn, were cut out and repointed. The central joint in the granolithic covering of Echo Bridge was pointed with elastic cement.



The paved slopes of the aqueduct embankment in Farm Pond have been repaired. The iron floor beams and gratings in the east siphon chamber and in the Course Brook, Bacon's and Fuller's waste-weirs, the stop-planks at the waste-weirs and the stairway railings at Echo Bridge, and iron doors and manhole covers at both the Echo and Waban bridges, have been painted.

The city of Newton has laid a surface water drain in Walnut Street, which is connected with manholes built on either side of a stone culvert 40 feet long, which was constructed under the aqueduct when it was built. The culvert was constructed 3 feet square, but a sewer and subdrain, embedded in concrete, have been laid through the lower portion, and the surface water is to be carried in the space 3 feet wide and 16 inches high remaining above the sewer.

The *Cochituate Aqueduct* was in use 216 days. It was cleaned from Lake Cochituate to the Chestnut Hill pumping station in April, with the exception of the siphon pipes at the crossing of the Charles River.

The work of setting property bounds along the aqueduct line, which has been in progress for several years, was completed in January, and in December 264 short property bounds were replaced by standard bounds 4 feet 6 inches long.

On December 9 the city of Newton began the work of laying a 15-inch Akron pipe sewer and a 12-inch Akron pipe underdrain under the aqueduct, at station 169, which is just west of the Waban Station on the Boston & Albany Railroad. The invert of the 12-inch underdrain at the point of crossing is 28 feet and 6 inches below the top of the aqueduct embankment. The material through which the sewer is laid is a very fine sand, holding sufficient water to give it a tendency to run into any excavation. Carefully sheeted trenches were excavated on either side of the aqueduct, and an attempt was made to force steel cylinders 6 feet long and from 4 feet to 4 feet 10 inches in diameter through the intervening distance of about 25 feet under the aqueduct. Three cylinders were forced in a total distance of 16 feet, and for the remaining distance cast-iron pipes to be used for the sewer and subdrain, were forced through the sand without the use of the steel cylinders. The Akron pipes were then laid through the cylinders and the cylinders filled with concrete. The flow through the aqueduct was stopped while the work was in progress, and the earth above the aqueduct was removed to relieve the pressure on the masonry. An inspection of the interior of the aque-

duct for 50 feet on either side of the crossing, made after the work was finished, revealed no indication of any settlement of the aqueduct or of the earth under it.

The *Weston Aqueduct* was in use 359 days. The portion of the aqueduct between siphon chamber No. 4 and the entrance to tunnel No. 4, a distance of 16,500 feet, was cleaned during the week ending April 13.

The building of a barn at the White place, for the use of the foreman, was completed during the winter, and late in the year a supply of water was brought into the barn by laying 210 feet of 1-inch pipe, connecting with a pipe leading from a small reservoir on the hill in the rear of the barn. Both the new and old barns have been painted, also all the ironwork in the head-house near the Sudbury Dam, the woodwork in the interior of the 4 siphon and 2 gaging chambers, and the manhole covers and iron ladders in the manholes between the head-house and siphon chamber No. 4.

#### PUMPING STATIONS.

Seventy-five per cent. of all the water supplied to the Metropolitan District has been pumped at the two stations at Chestnut Hill Reservoir; the remainder was delivered by gravity. The total quantity pumped at all the stations during the year was 38,213,520,000 gallons, which was 8.6 per cent. more than during the preceding year. The cost of operating the stations was \$112,248.67, equivalent to \$2.937 per million gallons pumped, or \$0.027 more than the corresponding cost during the year 1906. There was an increase in the cost of labor for operating the stations, amounting to \$5,604.81. This increase was due to two causes; first, to the decrease in the hours of labor of the pumping station employes from fifty-six to forty-eight hours per week, which went into effect on November 1, 1906, and necessitated an increase in the number of men employed, and second, to an increase of 10.6 per cent. in wages, which went into effect on April 1, 1907.

The cost per gross ton of fuel used at the Chestnut Hill high-service station was \$0.26 less and at the Chestnut Hill low-service station \$0.07 less, while at the Spot Pond station it was \$0.05 greater than during the preceding year. The increased cost of labor has been offset to some degree by a reduction in the price of fuel, which, in connection with the increase in the quantity pumped, has

resulted in making the average cost at all the stations of raising one million gallons one foot high exactly the same as during the year 1906, or \$0.0329.

All bituminous coal purchased for use at the several pumping stations has been tested to determine the number of British thermal units and the percentage of volatile matter and ash which it contained, and the cylinder and engine oils have been tested to determine their viscosity, specific gravity and burning point. Seventy-three samples of coal and 22 samples of oil were tested.

Coal for use at the several stations has been purchased as follows:—

	GROSS TONS.					Price per Gross Ton, in Bins.
	Chestnut Hill High- service Station.	Chestnut Hill Low- service Station.	Spot Pond Station.	West Roxbury Station.	Arling- ton Station.	
Wm. A. Jepson, bituminous, . .	1,688.14	-	-	-	-	\$4 14
E. B. Townsend, bituminous, . .	1,586.62	-	-	-	-	4 09
E. B. Townsend, bituminous, . .	-	896.61	-	-	-	4 00
Wm. A. Jepson, bituminous, . .	-	1,444.28	-	-	-	3 99
C. W. Claffin & Co., buckwheat an- thracite.	2,291.38	-	-	-	-	2 97
C. W. Claffin & Co., buckwheat an- thracite.	-	1,635.15	-	-	-	2 87
Locke Coal Company, bituminous, .	-	-	543.77	-	-	5 00
Locke Coal Company, bituminous, .	-	-	411.01	-	-	4 35
Locke Coal Company, screenings, .	-	-	424.51	-	-	2 24
D. J. Cutter & Co., anthracite, . .	-	-	-	350.53	-	7 28
Peirce & Winn Co., bituminous, . .	-	-	-	-	5.89	6 05
Locke Coal Company, bituminous, .	-	-	-	-	100.79	5 25
Wm. A. Jepson, bituminous, . .	-	-	-	-	23.39	5 07
Locke Coal Company, bituminous, .	-	-	-	-	199.94	5 00
Wm. A. Jepson, bituminous, . .	-	-	-	-	184.73	4 59
Locke Coal Company, bituminous, .	-	-	-	-	115.00	4 48
C. W. Claffin & Co., buckwheat an- thracite.	-	-	-	-	35.05	3 01
Peirce & Winn Co., screenings, . .	-	-	-	-	190.08	2 24
Total gross tons, bituminous, . .	3,274.76	2,340.89	954.78	-	629.74	-
Total gross tons, anthracite, . .	2,291.38	1,635.15	-	350.53	35.05	-
Total gross tons, anthracite screen- ings.	-	-	424.51	-	190.08	-
Average price per gross ton, bituminous,	\$4 12	\$3 99	\$4 72	-	\$4 84	-
Average price per gross ton, anthracite,	2 97 <sup>1</sup>	2 87 <sup>1</sup>	-	\$7 28	3 01 <sup>1</sup>	-
Average price per gross ton, anthracite screenings.	-	-	2 24	-	2 24	-

<sup>1</sup> Buckwheat.

*Chestnut Hill High-service Station.*

At this station water is pumped for use in the high-service district of Boston, the city of Quincy and the towns of Watertown, Belmont and Milton.

The following are the statistics relating to operations at this station:—

	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Totals for Station.
Total quantity pumped (million gallons), . . .	2,235.69	209.93	10,852.97	13,298.59
Daily average quantity pumped (gallons), . . .	6,125,000	575,000	29,734,000	36,434,000
Total coal used (pounds), . . . . .	3,639,708	208,364	8,961,000	12,809,072
Gallons pumped per pound of coal, . . . . .	614.25	1,007.52	1,211.13	2,939.97
Average head pumped against (feet), . . . . .	121.65	129.16	131.79	130.04
Cost of pumping:—				
Labor, . . . . .	\$5,785 17	\$269 56	\$14,680 63	\$20,735 36
Fuel, . . . . .	6,125 41	326 15	14,698 32	21,449 88
Repairs, . . . . .	1,463 32	1,274 23	911 35	4,648 90
Oil, waste and packing, . . . . .	134 88	6 29	342 28	483 44
Small supplies, . . . . .	193 30	9 01	490 54	692 85
Totals, . . . . .	\$13,702 08	\$4,885 23	\$32,423 12	\$48,010 43
Cost per million gallons pumped, . . . . .	\$6.29	\$8.980	\$2.987	\$3.610
Cost per million gallons raised 1 foot high, . . . . .	0.050	0.070	0.023	0.028

The daily average quantity pumped was 1,557,000 gallons, or  $4\frac{1}{2}$  per cent. more than during the previous year.

Between January 19 and March 22 extensive repairs were made on the furnaces of the No. 4 90-inch Belpaire boiler. The side sheets of the two furnaces, which were bulged and cracked, were cut out and replaced with four new sheets each 9 feet long, 33 inches wide and  $\frac{7}{16}$  of an inch thick. The work was done with great care, all rivet holes were drilled with the sheets in place, and the shanks of all rivets were turned in a lathe so as to fit the holes when the rivets were hot. The new stay bolts used were  $1\frac{1}{4}$  inches in diameter, or  $\frac{1}{8}$  of an inch larger than the old ones. The work was difficult, owing to the construction of the boiler, but was successfully accomplished, and the boiler has been in use since May 11, with no

signs of leakage. The work on the boiler was done by the Hodge Boiler Works of East Boston, at a cost of \$1,791, and the work of removing the boiler covering, raising and lowering and reconnecting the boiler was done by the regular pumping station force, at a cost of about \$300. The exterior woodwork and ironwork of the pumping station was repainted in October and November, and considerable of the interior woodwork refinished. In connection with the installation of a new boiler, concrete foundations have been placed under boilers Nos. 1 and 2. These boilers were originally erected on a foundation of concrete 4 feet in thickness, which in turn rested on filling about 13 feet in depth, which contained large tree stumps and other organic matter. As a result of these conditions the boilers settled several inches, and to prevent further settlement four concrete piers  $2\frac{1}{2}$  feet by 6 feet were built under each boiler, extending down to hard material, which was, on the average,  $17\frac{1}{2}$  feet below the engine room floor. A concrete arch 21 feet 9 inches long, having a span of 5 feet, a rise of 22 inches and a thickness of 8 inches at the crown, was built between the foundations of boilers Nos. 1 and 2 to form the foundation for the new boiler. The concrete used in constructing the piers and arch was made with Alpha Portland cement, sand and stone, mixed in the proportion of one part of cement, three of sand and six of stone. The cost of these foundations was approximately \$1,200.

On August 31 the high-pressure piston of the No. 2 Holly engine became detached from the piston rod, and as a result the rear cylinder head of the engine was blown out, rendering the engine useless. Arrangements were at once made with The Atlantic Works of East Boston to make a new cylinder and piston. The making of new patterns and castings, and of doing the necessary machine work, occupied about three months. The new cylinder was delivered at the station on December 13, and at the end of the year the engine was nearly ready to be placed in service.

#### *Chestnut Hill Low-service Pumping Station.*

The quantity of water pumped at this station was 11.9 per cent. more than during the preceding year.

The following are the statistics relating to operations at this station:—



	Engines Nos. 5, 6 and 7.
Total quantity pumped (million gallons), . . . . .	21,198.08
Daily average quantity pumped (gallons), . . . . .	58,077,000
Total coal used (pounds), . . . . .	9,057,261
Gallons pumped per pound of coal, . . . . .	2,340.45
Average head pumped against (feet), . . . . .	54.70

## Cost of pumping : —

Labor, . . . . .	\$18,494 76
Fuel, . . . . .	15,163 81
Repairs, . . . . .	816 35
Oil, waste and packing, . . . . .	475 98
Small supplies, . . . . .	428 07

Total for station, . . . . . \$35,378 97

Cost per million gallons pumped, . . . . . \$1.669

Cost per million gallons raised 1 foot high, . . . . . 0.031

The cost per million gallons pumped was \$0.021 less than for the year 1906.

No repairs of any magnitude have been necessary on either the engine or boilers, and the machinery is now in good condition. The exterior woodwork of the station has been painted.

*Spot Pond Pumping Station.*

At this station practically all of the water was pumped with the 20,000,000-gallon Holly engine, engine No. 8 having been in operation only ninety-five hours and thirty minutes during the year.

The following are the statistics relating to operations at this station : —

	Totals for Station. Engines Nos. 8 and 9.
Total quantity pumped (million gallons), . . . . .	3,267.82
Daily average quantity pumped (gallons), . . . . .	8,953,000
Total coal used (pounds), . . . . .	2,816,358
Gallons pumped per pound of coal, . . . . .	2,106.28
Average head pumped against (feet), . . . . .	129.76

## Cost of pumping : —

Labor, . . . . .	\$8,571 09
Fuel, . . . . .	5,055 61
Repairs, . . . . .	141 65
Oil, waste and packing, . . . . .	240 06
Small supplies, . . . . .	240 59

Totals, . . . . . \$14,249 00

Cost per million gallons pumped, . . . . . \$4.360

Cost per million gallons raised 1 foot high, . . . . . 0.034

The cost per million gallons pumped was \$0.334 more than for the previous year. There was an increase of \$0.39 per million gallons in the cost of labor and \$0.07 in the cost of fuel, these increases being offset by a decrease in the cost of repairs and small supplies.

The exhaust valve stem on the No. 8 engine was broken on August 13 while starting the engine after it had been out of service for several months, and on August 15 a dash pot and collar broke on engine No. 9. In both cases the repairs were made by the regular force, at small expense.

During October and November the exterior woodwork and ironwork of the station was given two coats of paint, and the interior wood finish was cleaned and varnished.

### *Arlington Pumping Station.*

At this station was pumped all the water supplied to the town of Lexington and to the high-service district of Arlington.

The following are the statistics relating to operations at this station:—

Pumps operated 8,710 hours 30 minutes; average, 24 hours per day.	
Daily average quantity of water pumped (gallons), . . . . .	636,000
Daily average quantity of coal consumed (pounds), . . . . .	4,370
Gallons pumped per pound of coal, . . . . .	146
Average lift in feet, . . . . .	282
Cost of pumping:—	
Labor, . . . . .	\$4,316 71
Fuel, . . . . .	3,552 96
Repairs and small supplies, . . . . .	422 93
Total for station, . . . . .	\$8,292 60
Cost per million gallons pumped, . . . . .	\$35.729
Cost per million gallons raised 1 foot high, . . . . .	0.127

On account of unexpected delays in the erection of the machinery in the new station, which has been under construction for two years, the old engines have been kept in service nearly the entire year. The Allis-Chalmers engine at the new station was operated for short periods on a few days during the latter part of November, and has been in regular service since December 6. As the reserve engine in the new station is not yet erected, fires are still maintained under the boilers at the old station, so that the plant is in readiness

for immediate use. On account of the necessity of maintaining fires at both the old and new stations, and on account of the increased cost of labor, the cost of operation has been larger than during the preceding year.

### *West Roxbury Pumping Station.*

At this station water was pumped for supplying the higher portions of West Roxbury and Milton.

The following are the statistics relating to operations at this station:—

Pumps operated 8,335 hours 30 minutes; average, 23 hours per day.	
Daily average quantity of water pumped (gallons), . . . .	594,000
Daily average quantity of coal consumed (pounds), . . . .	2,127
Gallons pumped per pound of coal, . . . . .	279
Average lift in feet, . . . . .	139
Cost of pumping:—	
Labor, . . . . .	\$3,471 11
Fuel, . . . . .	2,552 13
Repairs and small supplies, . . . . .	294 43
<hr/>	
Total for station, . . . . .	\$6,317 67
Cost per million gallons pumped, . . . . .	\$29.124
Cost per million gallons raised 1 foot high, . . . . .	0.210

The quantity pumped was 52,000 gallons per day, or 8 per cent., less than during the previous year, due to the discovery and repair in the latter part of 1906 of a number of leaks in the piping system in West Roxbury.

No extensive repairs have been required on the machinery, but the pumps are old, and, as it is necessary at times to operate both of the pumps to their full capacity, it will be necessary within a very few years to enlarge the plant unless a considerable reduction in the consumption can be made by saving water now wasted.

### CONSUMPTION OF WATER.

The daily average quantity of water consumed in the cities and towns supplied from the Metropolitan Water Works during the year 1907, as measured by the Venturi meters, was 124,135,100 gallons, equal to 133 gallons per inhabitant in the district supplied. In addition to the above, 50,000 gallons daily were supplied to the United

States Government reservation on Peddock's Island. The daily average quantity supplied to the Metropolitan Water District, as determined by pump measurement and by the flow in the Weston Aqueduct and the estimated yield of Spot Pond, was 125,071,000 gallons, equal to 133.8 gallons per inhabitant. The excess difference of 885,900 gallons per day between the quantity delivered by the aqueducts and that measured by meters to the several municipalities is due to differences in methods of measurement, to leakage from the Metropolitan Water Works reservoirs and pipes, and to the use of water at the Chestnut Hill and Spot Pond pumping stations.

The daily average consumption of water in each of the cities and towns supplied from the Metropolitan Works during the years 1906 and 1907, as measured by the Venturi meters, was as follows:—

	Estimated Population. 1907.	DAILY AVERAGE CONSUMPTION.					
		1906.		1907.		Increase.	Decrease.
		Gallons.	Gallons per Capita.	Gallons.	Gallons per Capita.		
Boston, . .	612,580	90,951,800	151	96,422,800	157	5,471,000	-
Somerville, . .	72,540	6,301,000	89	6,548,400	90	247,400	-
Malden, . .	39,820	2,000,100	51	1,857,100	47	-	143,000
Chelsea, . .	38,650	3,694,000	97	3,761,000	97	67,000	-
Everett, . .	31,350	2,441,600	81	2,555,000	81	113,400	-
Quincy, . .	29,390	3,021,800	107	2,996,900	102	-	24,900
Medford, . .	20,700	2,014,100	100	2,172,700	105	158,600	-
Melrose, . .	14,870	1,591,300	109	1,748,000	118	156,700	-
Revere, . .	14,020 <sup>1</sup>	1,093,200	82	1,240,700	88	147,500	-
Watertown, . .	11,930	771,300	67	796,800	67	25,500	-
Arlington, . .	10,220	800,800	81	939,800	92	139,000	-
Milton, . .	7,320	350,300	49	339,800	46	-	10,500
Winthrop, . .	7,580	819,800	113	883,400	117	63,600	-
Stoneham, . .	6,510	441,200	69	606,900	93	165,700	-
Belmont, . .	4,560	272,900	62	331,100	73	58,200	-
Lexington, . .	4,420	335,000	79	324,000	73	-	11,000
Nahant, . .	1,850	131,900	71	135,400	73	3,500	-
Swampscott, . .	6,420	492,500	79	475,300	74	-	17,200
District, . .	934,730	117,524,600	128	124,135,100	133	6,610,500	-

<sup>1</sup> Includes 270 people in Saugus.

The consumption in the several districts was as follows:—

	Gallons per Day.	Increase (Gallons per Day).
Southern low-service district, embracing the low-service district of Boston, with the exception of Charlestown and East Boston, . . . . .	50,973,100	3,203,300
Northern low-service district, embracing the low-service districts of Somerville, Chelsea, Malden, Medford, Everett, Arlington, Charlestown and East Boston, . . . . .	28,069,200	1,811,000
Southern high-service district, embracing the high-service districts of Boston, Quincy, Watertown, Belmont, and a portion of Milton, . . . . .	34,949,500	1,079,200
Northern high-service district, embracing Melrose, Revere, <sup>1</sup> Winthrop, Swampscott, Nahant and Stoneham, and the high-service districts of Somerville, Chelsea, Malden, Medford, Everett and East Boston, . . . . .	8,911,900	602,600
Southern extra high-service district, embracing the highest portions of West Roxbury and Milton, . . . . .	595,600	50,800 <sup>2</sup>
Northern extra high-service district, embracing Lexington and the highest portions of Arlington, . . . . .	635,800	34,800 <sup>2</sup>
Totals, . . . . .	124,135,100	6,610,500

<sup>1</sup> Includes a small part of Saugus.

<sup>2</sup> Decrease.

The increase of 6,610,500 gallons per day in the quantity of water used, as compared with the preceding year, was due, in a large degree, to the much colder weather during the months of January and February, resulting in a large waste to prevent freezing of water on premises of the water takers. The daily average consumption for the month of February was 146,118,200 gallons, equal to 158 gallons per inhabitant, or 22,766,500 gallons per day more than during the corresponding month in 1906. The reduction in the amount wasted from this cause, which is affected by the general use of meters, is well illustrated by comparing the per capita consumption in some of the municipalities where meters have been in use for several years with those where the water is paid for at schedule rates.

*Consumption per Inhabitant in Gallons per Day.*

	METERS IN GENERAL USE.			METERS NOT IN GENERAL USE.	
	November, 1906.	February, 1907.		November, 1906.	February, 1907.
Malden, . . .	48	52	Chelsea, . . .	83	156
Watertown, . .	69	61	Melrose, . . .	101	125
Milton, . . .	43	40	Revere, . . .	68	111
Belmont, . . .	52	58	Winthrop, . .	98	129



Another cause for the increase in the consumption of water during the year was the use for watering lawns and gardens during the dry weather in July and August. The increase from this cause was especially noticeable in the towns of Arlington and Belmont, where large quantities of water are used by market gardeners. The daily average consumption in Arlington for the month of August was 1,520,000 gallons, as compared with 775,800 gallons during the month of April, an increase of 744,200 gallons per day. The proportionate increase in Belmont was also very large, and there was a considerable increase throughout the suburban portions of the District.

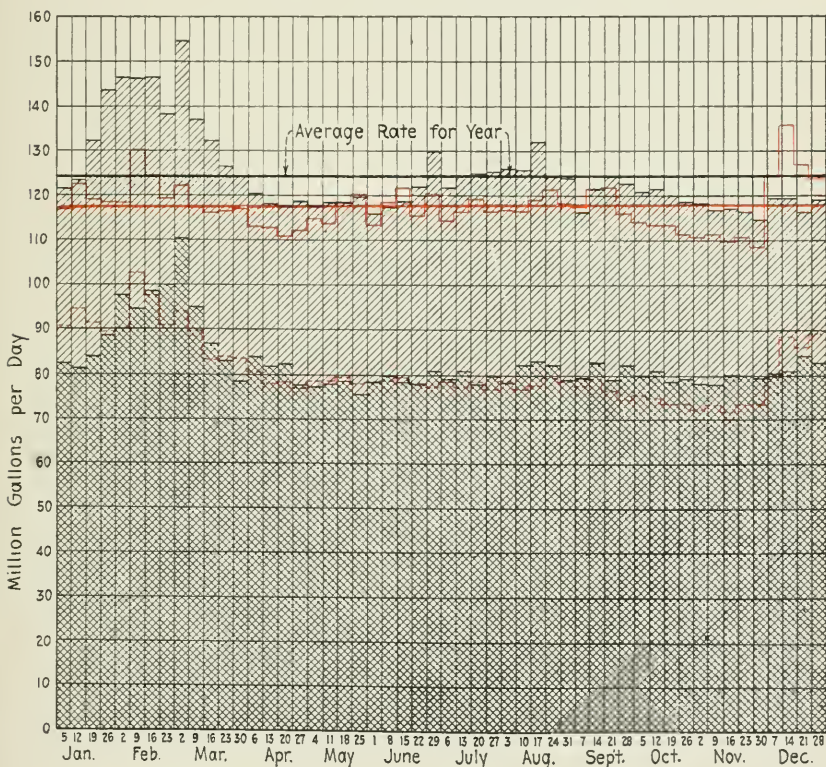
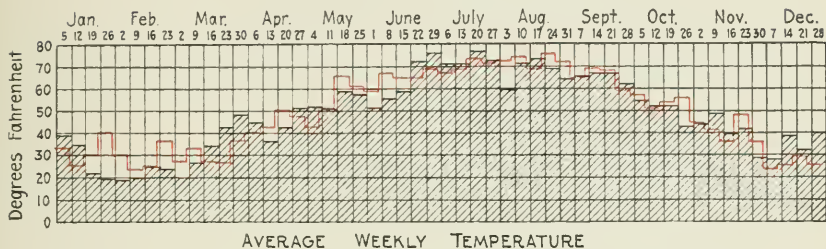
In ten municipalities there was an increase and in five a decrease in the per capita use of water. In the town of Stoneham the per capita consumption rose from 69 gallons in 1906 to 93 gallons in 1907, an increase of nearly 35 per cent. As the increase in the night rate was approximately the same as the increase in the daily average, it is probable that the increase of 165,700 gallons per day was due to one or more leaks in the pipe system of the town. As a result of this increase the water assessment of the town will be increased about \$1,500 per annum during the coming year.

The diagram facing this page shows graphically the average rate of consumption in the district supplied by the Metropolitan Works for each week during the years 1906 and 1907, also the rate of consumption between the hours of 1 and 4 A.M., and the average temperature of air for the week.

The great increase in the use or waste of water during cold weather is well illustrated by comparing the lines showing the average weekly consumption in January, February, March and December, 1907, with those for the corresponding time in 1906. From the middle of January until the middle of March the temperature during 1907 was much lower than in 1906, the average for several weeks being from 10 to 20 degrees less, while the month of December was much warmer in 1907 than in 1906. As a result, the daily average consumption from January 12 to March 16 was 141,664,000 gallons in 1907, while it was only 120,885,000 gallons in 1906. For the week ending March 2 the daily average consumption was 154,500,000 gallons, or 30,364,900 gallons above the daily average for the year.

The number of new meters set during the past year in the cities

AVERAGE RATE OF CONSUMPTION  
— IN —  
METROPOLITAN WATER DISTRICT  
— AND —  
AVERAGE TEMPERATURE OF AIR AT CHESTNUT HILL RESERVOIR  
— FOR —  
EACH WEEK DURING 1907



Average Rate of Consumption for each week, thus.....

..... between 1 and 4 A.M. for each week, thus.....

Average Rates in 1906 shown in red.



and towns supplied from the Metropolitan Works was 4,334, or 77 more than during the previous year. The number of meters set in the different cities and towns, with the percentage of the total number of services metered at the end of the year, was as follows: —

CITY OR TOWN.	Number added during 1907.	Per Cent. of Services metered Dec. 31, 1907.	CITY OR TOWN.	Number added during 1907.	Per Cent. of Services metered Dec. 31, 1907.
Boston, . . .	100	5.52	Arlington, . .	183	43.29
Somerville, . .	625	29.55	Milton, . . .	1	100.00
Malden, . . .	197	96.10	Winthrop, . .	25	3.37
Chelsea, . . .	840	27.14	Stoneham, . .	5	2.25
Everett, . . .	15	2.25	Belmont, . . .	38	100.00
Quincy, . . .	646	24.30	Lexington, . .	65	10.96
Medford, . . .	133	13.29	Nahant, . . .	17	21.95
Melrose, . . .	926	30.85	Swampscott, . .	416	68.25
Revere, . . .	30	5.57	Total, . . .	4,334	17.36
Watertown, . .	72	100.00			

The number of meters now in use in the several cities and towns is shown in Appendix No. 2, Table No. 38.

#### QUALITY OF THE WATER.

The quality of the water supplied to the Metropolitan District has continued good throughout the year. The number of microscopic organisms has been smaller than during the two previous years and the color substantially the same.

Samples of the water have been collected monthly from 24 points, and semimonthly from 5 points on the works, and sent to the State Board of Health for chemical analysis. Samples of water have also been collected weekly at 35 points and biweekly at 8 points, and examined microscopically and for color, odor, taste and turbidity in the biological laboratory of the Metropolitan Water and Sewerage Board.

The following table gives a comparison of the average results of the examinations of water from a tap in Boston for the years 1900 to 1907, inclusive: —

	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
<i>State Board of Health Examinations.</i>								
Color (Nessler standard), . . .	0.24	0.24	0.26	0.25	0.23 <sup>1</sup>	0.24 <sup>1</sup>	0.24 <sup>1</sup>	0.22 <sup>1</sup>
Total residue, . . . . .	3.80	4.43	3.93	3.98	3.93	3.86	3.86	3.83
Loss on ignition, . . . . .	1.20	1.64	1.56	1.50	1.59	1.59	1.39	1.40
Free ammonia, . . . . .	0.0012	0.0013	0.0016	0.0013	0.0023	0.0020	0.0018	0.0013
Albuminoid am- { total, . . . . .	0.0157	0.0158	0.0139	0.0125	0.0139	0.0145	0.0159	0.0129
monia, { dissolved, . . . . .	0.0138	0.0143	0.0119	0.0110	0.0121	0.0124	0.0134	0.0109
{ suspended, . . . . .	0.0019	0.0015	0.0020	0.0015	0.0018	0.0021	0.0025	0.0020
Chlorine, . . . . .	0.25	0.30	0.29	0.30	0.34	0.35	0.34	0.33
Nitrogen as nitrates, . . . . .	0.0076	0.0173	0.0092	0.0142	0.0110	0.0083	0.0054	0.0068
Nitrogen as nitrites, . . . . .	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Oxygen consumed, . . . . .	0.38	0.42	0.40	0.39	0.37	0.35	0.36	0.32
Hardness, . . . . .	1.3	1.7	1.3	1.5	1.5	1.4	1.3	1.3
<i>Metropolitan Water and Sewerage Board Examinations.</i>								
Color (platinum standard), . . .	34	34	33	35	32	28	25	27
Turbidity, . . . . .	-	2.0	2.3	2.2	2.4	1.9	2.2	2.2
Total organisms, . . . . .	468	243	367	286	303	528	550	427
Amorphous matter, . . . . .	97	38	34	36	36	37	42	47
Bacteria, . . . . .	181	162	164	126	176	231	154	176

NOTE.—Chemical analyses are in parts per 100,000, organisms and amorphous matter in standard units per cubic centimeter, and bacteria in number per cubic centimeter. The standard unit has an area of 400 square microns, and by its use the number of diatomaceæ are decreased, and the number of chlorophyceæ and cyanophyceæ are very much increased, as compared with the number of organisms.

<sup>1</sup> Platinum standard.

In the biological laboratory there have been made 2,624 microscopical, 1,212 biological and 24 chemical examinations of water collected at various points upon the works. Of the microscopical examinations, 1,996 were of the regular weekly and biweekly samples, and 628 were special examinations.

The bacteriological work consisted of routine weekly examinations, monthly examinations of the main feeders of the Sudbury Reservoir, of Framingham Reservoir No. 3 and of Lake Cochituate, and monthly tests of the efficiency of the Pegan Brook, Marlborough Brook and Sterling filter-beds.

The organisms in the Wachusett Reservoir have been small in number and generally unobjectionable in character. A growth of *Uroglena*, which caused an objectionable taste and odor, was present in the water near the surface of the reservoir, in the vicinity of the dam, for about two weeks in June, but the water at a greater depth was not affected. The examinations made by the State Board of Health show that the color of the water and the quantities of both free and albuminoid ammonia were lower than during the preceding year.

The water in the Sudbury Reservoir, and in Framingham Reservoir No. 3, is largely supplied from the Wachusett Reservoir, and



like the water in that reservoir has been of better quality than in previous years. The number of organisms present in the water of both these reservoirs was less than for any year since 1904. Two growths of *Uroglena* developed in the Sudbury Reservoir, one in June and the other in November, the latter continuing to the end of the year, but the number of organisms present was not sufficient to cause objectionable taste and odor in the water delivered to the Metropolitan District.

In Lake Cochituate the number of organisms was larger than in any other source, with the exception of Whitehall Reservoir. Objectionable organisms were present nearly all of the time, and for about one-third of the year in sufficient numbers to make the water undesirable for use.

The organisms in the Ashland and Hopkinton reservoirs have been few in number and unobjectionable in character.

The water in the distributing reservoirs has generally been free from large numbers of organisms.

From May 27 to June 18 there was a large growth of *Uroglena* in the Waban Hill Reservoir, and growths of the same organism in the Mystic Reservoir made it necessary to shut that reservoir off from the pipe system from April 10 to 18.

#### SANITARY INSPECTION.

The sanitary inspection of the watersheds has been continued under the immediate supervision of William W. Locke, C.E., Sanitary Inspector.

On the Wachusett watershed 2 cases of typhoid fever were reported in Holden, 2 in Princeton, 1 in Sterling and 1 case of dysentery in Holden, as compared with 11 cases of typhoid fever during the previous year.

On the Sudbury and Cochituate watersheds 11 cases of typhoid fever were reported in Marlborough, 7 in Natick, 7 in South Framingham and 5 in Westborough, a total of 30, as compared with 44 during the year 1906.

There were no epidemics, and in 18 cases the patients resided in houses connected with the public sewers which discharge outside the watershed.

The sanitary conditions on the Wachusett watershed have been improved during the year by the demolition of 10 buildings on prop-

erty belonging to the Board, by the construction of 3 cesspools and 1 cemented brick privy vault in Sterling, by the completion of 2 acres of filter-beds, constructed for the purpose of purifying the water of the brook which receives unsanitary drainage from about 225 acres in Sterling, including the thickly settled portion of the town, and by the construction of 4 small sand filter-beds for purifying the drainage from 5 dwellings near the Sterling camp grounds.

On the Sudbury watershed 94 old and 7 new premises were connected with the public sewers which convey the drainage outside the watershed; 45 of these premises are in Marlborough, 52 in Westborough and 4 in Framingham.

On the Cochituate watershed 69 old and 19 new premises were connected with the public sewers; 41 of these are in Framingham and 47 in Natick.

At the request of the Board tight floors have been laid by the railroad companies on the New York, New Haven & Hartford Railroad bridge crossing Framingham Reservoir No. 3, and on the Boston & Albany Railroad bridge over the Sudbury River just above Framingham No. 2, for the purpose of preventing direct pollution of the water from passing trains.

Considerable time has been devoted to inspection to prevent the pollution of the water supply by large gangs of men engaged in building and repairing State highways in Boylston, West Boylston and Holden, in widening and reconstructing Worcester Street between Framingham and Fayville, in widening the road-bed of the Boston & Albany Railroad between Natick and South Framingham, and in laying water pipes for the Westborough Insane Hospital in Crane Swamp.

A summary of the work of sanitary inspection for the year 1907 is given in the following four tables. The first table shows for the Wachusett watershed the number of premises inspected, the classification of cases inspected, and the condition of the premises at the end of the year; the second table gives the corresponding information for the Sudbury and Cochituate watersheds; the third table shows the improvements effected on the Wachusett watershed; and the fourth table the improvements effected on the Sudbury and Cochituate watersheds.

The headings of these tables are easily understood, except in a few instances: under the heading "Premises Vacant" are included all

cases which at present furnish no objectionable drainage, but which might furnish such drainage if the premises were occupied; under the heading "Unsatisfactory" are included all cases where there may be, under the most unfavorable conditions, wash from privies or direct sink drainage, all suspected cases, and all cases of manufacturing wastes entering feeders, even though there may be some attempt at previous purification.

In the third and fourth tables no cases are entered as remedied unless complete sewer connections have been made, or all probability of future contamination has been removed; and no cases are entered as partly remedied except where positive improvement in the sanitary condition has been effected.

*Summary of Sanitary Inspections on the Wachusett Watershed in 1907.*

DISTRICT.	Number of Premises inspected. <sup>1</sup>	CLASSIFICATION OF CASES INSPECTED.									CONDITION AT END OF YEAR.	
		Cesspools dug before 1907.	Cesspools dug in 1907.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	Indirect Sink Drainage.	Manure Piles.	Manufacturing Wastes.	Premises Vacant.	Satisfactory.	Unsatisfactory.
French Brook, . . .	66	30	1	-	-	-	10	33	-	5	63	3
Muddy Brook, . . .	32	9	1	-	-	-	7	24	-	-	32	-
Gates Brook, . . .	138	89	6	-	-	-	4	58	-	8	136	2
Malden Brook, . . .	17	9	-	-	-	-	-	14	-	1	17	-
Chaffin Brook, . . .	160	72	6	-	1	-	13	77	1	14	148	12
Asnebumskit Brook, . .	281	147	10	5	8	24	25	96	2	10	239	42
Muschopauge, . . .	95	26	-	-	5	6	10	51	1	6	80	15
South Wachusett Brook, .	82	22	1	2	1	4	3	36	-	10	74	8
Trout Brook, . . .	38	4	-	-	-	-	3	26	-	5	36	2
East Wachusett Brook, .	210	62	1	2	8	7	23	109	-	7	186	24
Stillwater River, . . .	150	46	1	-	6	2	11	85	-	4	134	16
Waushacum, . . .	164 <sup>2</sup>	43	6	-	4	1	8	60	-	9	150	14
French Hill, . . .	28	15	2	-	-	-	-	15	-	4	28	-
Totals, . . .	1,461	574	35	9	33	44	117	684	4	83	1,323	138

<sup>1</sup> On some premises there are 2 or more cases.

<sup>2</sup> Not including 204 summer cottages located near the Waushacum Lakes.

*Summary of Sanitary Inspections on the Sudbury and Cochituate Watersheds in 1907.*

DISTRICT.	Number of Premises in- spected. <sup>1</sup>	CLASSIFICATION OF CASES INSPECTED.								CONDITION AT END OF YEAR.			
		Cesspools dug before 1907.	Cesspools dug in 1907.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	Indirect Sink Drainage.	Manure Piles.	Manufacturing Wastes.	Premises Vacant.	Satisfactory.	Unsatisfactory.	
<i>Sudbury Watershed.</i>													
Farm Pond, . . . . .	245	16	-	-	-	-	1	20	-	6	243	2	
Framingham Reservoir No. 3, . . . . .	71	33	2	-	-	-	35	50	-	1	67	4	
Stony Brook, . . . . .	289	203	5	-	3	4	46	113	-	17	268	21	
Angle Brook, . . . . .	1,978	293	3	-	4	5	138	250	1	67	1,908	70	
Framingham Reservoirs Nos. 1 and 2, and Cold Spring Brook, . . . . .	271	99	5	-	2	-	105	112	-	27	261	10	
Eastern Sudbury, . . . . .	238	204	12	-	2	-	46	43	-	5	226	12	
Indian Brook, . . . . .	419	169	12	-	7	-	166	83	-	61	386	33	
Western Sudbury, . . . . .	184	63	1	-	3	3	77	53	1	32	157	27	
Whitchall Reservoir, . . . . .	111	22	-	-	1	1	74	37	-	11	100	11	
Cedar Swamp, . . . . .	809	209	-	-	1	6	89	128	-	51	792	17	
<i>Cochituate Watershed.</i>													
Snake Brook, . . . . .	320	221	-	-	-	3	93	68	-	8	296	24	
Pegan Brook, . . . . .	921	253	2	-	2	4	77	110	1	29	893	28	
Course Brook, . . . . .	88	49	-	-	-	-	29	41	-	8	86	2	
Beaver Dam Brook, . . . . .	1,083	191	2	-	4	3	88	183	3	16	1,036	47	
Dug Pond, . . . . .	500	172	-	-	3	7	36	49	-	8	478	22	
Totals, . . . . .	7,527	2,197	24	-	27	43	1,100	1,340	6	347	7,197	330	

<sup>1</sup> On some premises there are 2 or more cases.

*Sanitary Improvements effected on the Wachusett Watershed in 1907.*

DISTRICT.	Remedied by Filter-bed.	Otherwise remedied. <sup>1</sup>	Partly remedied.
French Brook, . . . . .	-	7	2
Muddy Brook, . . . . .	-	-	-
Gates Brook, . . . . .	-	-	-
Malden Brook, . . . . .	-	-	-
Chaffin Brook, . . . . .	-	-	-
Asnehumskit Brook, . . . . .	-	-	2
Muschopauge, . . . . .	-	2	-
South Wachusett Brook, . . . . .	-	1	-
Trout Brook, . . . . .	-	1	-
East Wachusett Brook, . . . . .	-	-	-
Stillwater River, . . . . .	-	-	-
Wachusett, . . . . .	30	1	4
French Hill, . . . . .	-	-	-
Totals, . . . . .	30	12	8

<sup>1</sup> Including buildings torn down or removed.

*Sanitary Improvements effected on the Sudbury and Cochituate Watersheds in 1907.*

DISTRICT.	Remedied by Sewer Connection.	Otherwise remedied. <sup>1</sup>	Partly remedied.	Cesspools abandoned on Account of Sewer Connections.
<i>Sudbury Watershed.</i>				
Farm Pond, . . . . .	3	-	-	3
Framingham Reservoir No. 3, . . . .	-	-	2	-
Stony Brook, . . . . .	-	-	5	-
Angle Brook, . . . . .	39	1	3	25
Framingham Reservoirs Nos. 1 and 2 and Cold Spring Brook.	-	1	5	-
Eastern Sudbury, . . . . .	-	2	2	-
Indian Brook, . . . . .	-	4	2	-
Western Sudbury, . . . . .	-	-	1	-
Whitehall Reservoir, . . . . .	-	-	-	-
Cedar Swamp, . . . . .	52	2	-	49
<i>Cochituate Watershed.</i>				
Snake Brook, . . . . .	-	-	-	-
Pegan Brook, . . . . .	21	-	2	21
Course Brook, . . . . .	-	-	-	-
Beaver Dam Brook, . . . . .	28	1	3	26
Dug Pond, . . . . .	20	-	-	20
Totals, . . . . .	163	11	25	144

<sup>1</sup> Including buildings burned, torn down or removed.

### SWAMP DITCHES AND BROOKS.

The drainage ditches in swamps on the several watersheds, aggregating 31.66 miles in length, not including those built during the past year, have been cleaned, and the weeds and brush mowed and burned for a width of from 10 to 20 feet on either side of the ditches. About 9,000 feet in length of the ditches on Angelico and Deerfoot brooks, near the Sudbury Reservoir, were repaired by repaving the slopes where the paving had been trampled out of place by cattle.

Beaver Dam Brook, which is one of the principal feeders of Lake Cochituate, runs through South Framingham and Natick for more than 2 miles with comparatively little fall, and there are obstructions in the channel which form pools in which objectionable matter collects during the summer when the flow of the brook is small. The brook was for much of its length bordered by a growth of shrubbery



which tended to conceal as well as to assist in catching matter which from time to time was thrown into the brook. During July and August all trees and shrubbery on both sides of the brook, for a distance of 10,000 feet, were cut. All débris, consisting of timber, roots of trees, old cans and objectionable matter of all kinds, was removed from the brook, and at several points deposits of silt, forming bars across the brook, were also removed. A survey of the brook from the Milford branch of the Boston & Albany Railroad to Lake Cochituate has been made with soundings to determine the depth of mud, for the purpose of preparing an estimate of the cost of more thoroughly improving existing conditions.

The work of draining the swampy land along the line of the Cochituate Aqueduct near Snake Brook, begun in 1906, was finished during the year. In order to prevent water from standing in a stagnant pool over the aqueduct, the ground has been raised for a distance of 800 feet, and a ditch 2,430 feet long built, of which about 900 feet were constructed during the past year.

The channel of Snake Brook for a distance of 850 feet easterly from the Natick and Cochituate Road has been much improved by constructing a channel 6 feet wide at the bottom, with side slopes of 1.5 to 1, both bottom and slopes covered with about 12 inches of gravel and paved with small stones, where necessary, to prevent washing. For a further distance of 1,050 feet, where the brook runs through clean gravel, the channel has been enlarged so as to have a bottom width of 4 feet, with side slopes of 1.5 to 1. In order to be able to prevent the use for pasturage of a considerable portion of the swampy land over the aqueduct, also of the land along the line of Snake Brook where the improvements above described have been made, 7.22 acres of land have been purchased, extending for 1,760 feet along the aqueduct line. Wire fencing, aggregating 1,233 feet in length, has been built to complete the enclosure of the land purchased, and 928 feet have been built alongside the new brook channel near the Natick and Cochituate road to prevent cattle from entering the brook.

#### FORESTRY.

At the Wachusett Reservoir the fire guard, 40 feet wide, along the margin of the land owned by the Board has been extended through timber and pasture land for about 2 miles in West Boylston. Boyls-

ton and Clinton, completing the guard around the entire limits of the Board's property on the margins of the reservoir.

The fruit and other undesirable trees have been cut on about 33 acres. An area of 20 acres was planted between May 7 and 18 with 26,000 two-year-old white pine seedlings, spaced in rows 6 feet apart each way. In 1906 there were planted on the Oakdale flats three groups of locusts, containing 100 trees each, and as these had largely failed they have been replaced.

The following table gives the information regarding land belonging to the Board around the reservoir, not including outlying land and land along the Quinepoxet River above the road which formerly crossed the river to the Harris Mills:—

	Acres.
Area of land which was forested when acquired, . . . . .	1,483
Area which has been planted with trees, . . . . .	1,117
Area to be planted with trees, . . . . .	315
Area open, which will probably not be planted, . . . . .	300
Area of marginal strip along shores of reservoir, . . . . .	197
	<hr/>
Total area, . . . . .	3,412

At the beginning of the year there remained to be planted with arbor vitæ about  $1\frac{1}{2}$  miles of the reservoir margin. As the major part of this species of trees, planted along the reservoir margin in years past, has failed, further planting of these trees has been postponed until a stock of larger trees can be obtained from the nurseries.

The necessary care has been given to the Flagg and Lamson nurseries. There were transplanted from the nursery beds to the transplant rows at the Flagg nursery 285,550 white pines and 13,330 arbor vitæ. This nursery now contains the following stock, all in transplant rows: 363,540 white pines, 28,300 arbor vitæ, 4,380 Scotch pines and 3,140 white spruces.

Because of the failure of the greater part of the arbor vitæ planted along the reservoir margin in years past, it has been deemed advisable, in transplanting this species of trees, to transfer as many as possible to the Lamson nursery, where the soil is much better adapted for them. Ordinarily, trees in transplant rows are spaced 3 inches apart in rows 6 inches apart, but those transplanted during the past year have been spaced 6 inches apart in rows 12 inches apart, so as to allow of their attaining suitable size before being planted out in

the reservoir margin. There were transplanted in this manner from the Flagg nursery to transplant rows in the Lamson nursery 154,200 arbor vite.

Besides this stock, this nursery contains, in transplant rows, 13,550 sugar maples, 8,810 locusts, 3,090 white oaks, 3,000 ashes, 2,300 walnuts, 700 Norway spruces and 54 catalpas.

Over a considerable portion of land which was planted with white pines and has since been covered with a thick growth of white birches, briars and alders, or lots which were originally covered with white birches and underplanted with white pines, it has been found necessary to cut out all trees and brush which would interfere with the progress of the young pines. An area covering about 166 acres of land has been so cleared, at a cost of about \$7.85 per acre.

Fifteen acres of land on Nashaway Island, which is covered with a ten-year-old forest of white oaks, maples and walnuts, has been improved by thinning out the trees, at a cost of about \$31 per acre.

An area of about 13 acres of timber land, covered with chestnuts, pines and maples about thirty years old, has been improved in a similar manner, at a cost of about \$28.50 per acre.

A strip about 15 feet wide has been cleared on each side of brooks through forested marginal lands, having an aggregate length of about 5,700 feet.

The logs obtained in doing the foregoing work have been cut into lumber and cordwood, the quantities obtained being as follows:—

10,900 feet B.M. hardwood dimension lumber;  
4,100 feet B.M. applewood lumber;  
455 cords of firewood.

Fifty-five cords of logs reported last year have been worked into lumber and are included in the above quantities.

All the above-mentioned work has been done by day labor, except the manufacture of the lumber, which was done at the saw mill of Lowe & Flagg in West Boylston.

At the Sudbury Reservoir 3,200 white pines were planted, a number of worthless apple trees cut down and either sold for firewood or burned, and a large quantity of brush remaining after the cutting of trees on Pine Hill was also collected and burned. Worthless apple trees were also cut on lands around Framingham reservoirs Nos. 2 and 3.

## DISTRIBUTING RESERVOIRS.

The distributing reservoirs maintained by the Board are the Weston and Chestnut Hill reservoirs; the Waban Hill and Forbes Hill reservoirs and the Forbes Hill standpipe of the southern high-service system; Spot Pond and the Mystic Reservoir near Tufts College, of the northern low-service system; the Fells and Bear Hill reservoirs of the northern high-service system, and the Arlington standpipe of the northern extra high-service system.

*Weston Reservoir.*

The reservoir and the buildings and grounds about it are in good condition. In addition to the usual care required to keep the grounds in good order, a large amount of work has been done in protecting the trees and shrubs from the ravages of the gypsy and brown-tail moths. This has included not only the destruction of the moths, but also the cutting and burning of the underbrush and the cutting of all apple trees.

*Chestnut Hill Reservoir.*

This reservoir, with its gate-houses and grounds, including the grounds around the pumping stations, has received the usual care. The gravel walk around the reservoir has been resurfaced for a distance of 2,200 feet, and 650 feet of new walk, with 4 catch basins, have been built near the east end of the reservoir. The driveways in the vicinity of the pumping stations have been resurfaced at a cost of \$1,637.79. Repairs have been made upon the copper roofs on the terminal chamber and effluent gate-house No. 2, and the window grilles and woodwork painted.

A surface water drain in Reservoir Lane became clogged by gravel and other material during a storm in January, causing the water to overflow into the basement of the high-service pumping station. For the purpose of preventing this from recurring, a concrete catch basin, having a capacity of 9 cubic yards, was built at the entrance to the drain, at a cost of about \$350.

*Waban Hill Reservoir.*

The grounds have received the usual care, and the reservoir and grounds are in good condition.

*Forbes Hill Reservoir and Standpipe.*

No other work than the usual care of the grounds and structures has been required at this reservoir. The standpipe has been in constant use, and the reservoir has been kept full of water and has not been drawn upon for the supply of the District.

*Spot Pond.*

During the extreme cold weather in February and the early part of March sufficient water for the supply of the Metropolitan District could not be drawn through the aqueducts, and it became necessary to draw a portion of the supply from Spot Pond, thus lowering its surface about 3 feet. The pond was refilled in the middle of May, and remained practically full throughout the remainder of the year.

In connection with the work of destroying gypsy and brown-tail moths, which is described elsewhere in the report, considerable work has been done in cutting undesirable trees.

The stone dwelling house, on what was known as the Butterfield estate, has been destroyed.

The reservoir with its structures and grounds are in good order.

*Mystic Reservoir.*

This reservoir has been in use throughout the year, with the exception of 18 days in April, when the water contained a growth of *Uroglena* which gave it an objectionable taste and odor.

The roof of the gate-house was painted, and both reservoir and grounds are in good condition.

*Fells and Bear Hill Reservoirs.*

The exterior wood and iron work of the gate-houses at both of these reservoirs was painted and the interior woodwork varnished.

*Arlington Standpipe.*

\* This standpipe was painted in 1906 and has since required no attention other than occasional inspection.



*Mystic Lake.*

The property here is in good condition. The club house of the Medford Boat Club was burned on January 28 and has since been rebuilt.

## PIPE LINES.

In April a 6-inch connection was made at Washington Square in Chelsea, between the 20-inch Metropolitan main and the 10-inch main of the Chelsea pipe system. This connection is to be used only in cases of emergency. In October an 8-inch branch was placed in the 16-inch main opposite the Chelsea Reservoir, and a connection made with the pipes of the city of Chelsea, for the purpose of supplying water under higher pressure to the Soldiers' Home and a few houses in the immediate vicinity.

At the Arlington pumping station 171 feet of 16-inch and 175 feet of 20-inch pipe have been laid for the force and suction mains of the engines in the new station.

A 36-inch valve has been set in the 48-inch pipe line in Reservoir Lane, in Brookline, near the high-service pumping station.

Thirty leaks have been repaired on the pipe lines, at a cost of \$1,354.97. There were no breaks in the pipes during the year. Twenty-seven of the leaks occurred at joints, and fourteen of them were on the pipe lines crossing the Charles and Mystic rivers, where the changes in the length of the pipes, due to changes in temperature, draw the pipes apart and cause leaks at the tapered joints. A diver and dredge were employed three weeks, at a cost of \$1,081.39, in repairing nine leaks in the two lines of 36-inch pipes crossing the Charles River near Cottage Farm.

The ironwork of the bridges which support the pipes over the railroads at Walnut Avenue in Somerville, College Avenue in Medford, and Adams Street in Milton has been cleaned and painted, and the sheet lead, which is used to protect the bottom of the bridge girders from the engine gases, was replaced with thicker lead. Bridges over the Boston & Albany Railroad at St. James Street in Newton, and over the Fitchburg Railroad at Massachusetts Avenue in Cambridge, were cleaned and painted, and the bottom of the girders of the Massachusetts Avenue bridge was covered with lead.

A new floor was laid on the bridge over the Mystic River in Medford, and the railings were painted. This bridge not only supports two lines of pipe but is also used by the public as a foot bridge.

#### VENTURI METERS.

The throat of the 20-inch meter at the junction of the Arborway and South Street in West Roxbury has been enlarged from 6.5 inches to 8 inches on account of the increased consumption in the district supplied through the meter. A 16-inch meter with a 5.25-inch throat was placed in the force main leading from the new Arlington pumping station.

In order to prevent the freezing of the meter registers a non-conducting coating of pitch and granulated cork was placed around the upper part of five register chambers located at the junction of Highland Avenue and Clifton Street in Malden, at Jerome and High streets in Medford, near the East Boston pumping station, at the junction of Webster Avenue and Newton Street in Somerville, and at the junction of Blue Hill Avenue and Morton Street in West Roxbury, at an average cost of about \$62 each.

#### PRESSURE REGULATORS AND RECORDING GAGES.

Pressure regulating valves have been continued in use during the year for reducing and regulating the water pressure in the pipes in Lexington, Winthrop, Swampscott and Nahant, also valves operated by floats for controlling the level of the water in the Revere and Chelsea reservoirs. They have been adjusted from time to time and, in general, control the pressure satisfactorily.

No changes have been made in the number of recording gages during the year, but one gage, formerly used in Nahant, has been transferred to the Water Department Office of the town of Winthrop.

The average maximum and minimum elevations of the water, due to the pressure at eighteen points in different parts of the District, as recorded by the gages, are given in Appendix No. 2, Table No. 40.

#### ELECTROLYSIS.

The electrical pressures between the pipe lines and street railway tracks were determined over the entire distribution system in March and April. Numerous measurements of the electrical pres-

tures on various portions of the system have also been made from time to time since the complete survey was finished. In general, the conditions, as shown by the surveys made in March and April, have not changed to any noticeable extent since last year, but there are indications of an increased rate of injury to the pipes from electrolysis during the past year on the northern high-service pipe line in Stoneham and on the supply pipe lines in Newton. Partial surveys made in October and November seem to indicate that the conditions are growing worse on the westerly 48-inch low-service pipe line between Chestnut Hill Reservoir and Spot Pond, and on the 42-inch low-service pipe line in Chelsea.

Twenty-four new gaging stations have been installed in order that more accurate determinations can be made of the currents flowing on the pipe lines. Measurements taken on the southern high-service 48-inch pipe line in Reservoir Lane in Brookline, about 300 feet from the high-service pumping station, at a time when the pipe line was cut for the purpose of setting a valve, showed that a current of electricity of from 45 to 75 amperes was flowing west on this pipe line toward the pumping station. A permanent gaging station has been established at this point so that measurements can be made from time to time in the future.

An insulating joint was placed between the northern high-service 20-inch pipe line and the Chelsea Water Works 10-inch pipe in Washington Square in Chelsea on April 18, when a connection was made between these two pipes. An insulating joint was also placed between the 48-inch low-service pipe line and the Malden Water Works 12-inch pipe line at the corner of Medford and Pearl streets in Malden, when changes were being made at that point on November 21. These joints were placed so that the flow of electricity between the Metropolitan pipe system and the local systems can be controlled, and the intensity and direction of the currents can be measured.

A comparison for the years 1906 and 1907 of the approximate average amount of electricity leaving the various pipe lines and flowing into the earth to cause damage to the pipes by electrolysis in the sections covered by our investigations indicate that the most serious injury is being done is as follows:—

DESCRIPTION OF PIPE LINE.	May and July, 1906, with Insulation Joints (Amperes leaving Pipes).	March and April, 1907, with Insulation Joints (Amperes leaving Pipes).
Easterly 48-inch low-service pipe line, Chestnut Hill Reservoir to Malden River.	75	70
Westerly 48-inch low-service pipe line, Chestnut Hill Reservoir to Mystic River.	137 <sup>1</sup>	105 <sup>2</sup>
42-inch low-service pipe line in Chelsea, . . . . .	100	55 <sup>2</sup>
24-inch low-service pipe line across Chelsea Creek, . . . . .	10	5
16-inch high-service pipe line, Boston Avenue, Medford, . . . . .	25	10
20-inch high-service pipe line, Stoneham, . . . . .	20	25
20-inch and 12-inch high-service pipe lines in Lynn, . . . . .	50	50
12-inch high-service pipe line, Hyde Park, . . . . .	5	5
48-inch supply pipe line, Newton, . . . . .	20	25

<sup>1</sup> Insulation joint at Porter Square broken down.

<sup>2</sup> Measurements made in October and November show much larger currents leaving this pipe line.

Measurements made in November, between 4.30 and 6.30 P.M., which is the period when the travel on the street railways is heaviest, showed that the currents flowing on the pipes were then more than twice as large as the average current between 9.30 A.M. and 4.30 P.M. As it is impossible to take all of the measurements on even a single pipe line simultaneously, the foregoing figures are approximate averages only, because a street railway load is very changeable, and in some cases it has been necessary to adjust the various results in order to compare them.

The westerly 48-inch low-service pipe line between Chestnut Hill Reservoir and Spot Pond was uncovered at seven points in the vicinity of the Harvard power station during October and November, and was carefully examined to determine the extent of the damage from electrolysis. Two of the excavations made on this line were in North Harvard Street, 500 feet north of Western Avenue in Brighton, on pipe which had not previously been examined, because there was no indication that any appreciable damage was being done here until the electrical conditions were altered by setting insulating joints on this pipe line. About 300 square feet of pipe surface were examined and 28 small pits were found, none of them, however, being more than  $\frac{1}{8}$  of an inch deep. An examination was made of the pipe just south of and on the positive side of the insulating joint in North Harvard Street, about 200 feet south of the Charles River. On this pipe 150 pits about  $\frac{3}{4}$  of an inch in diam-

eter and not over  $\frac{1}{8}$  of an inch deep, and 4 pits or patches about 75 square inches in area and not over  $\frac{3}{16}$  of an inch deep, were found on 170 square feet of pipe surface. The pipe line had not previously been examined at this point. An insulating joint was set here in August, 1904.

The examination of the two lines of 36-inch pipe on the Boston shore of the Charles River, just above low-water line, showed that there were about 72 pits, from  $\frac{1}{8}$  to  $\frac{5}{16}$  of an inch deep, in 300 square feet of pipe surface. Plaster casts were made of 4 of the larger pits. Two of the casts were taken of pits from which casts had been previously taken, in June, 1903, and a comparison of the casts shows considerable increase in area of pit and slight increase in depth.

Just north of and on the positive side of the insulating joint on Boylston Street at Charles River Road in Cambridge, and about 200 feet north of the Charles River, 200 square feet of pipe surface were examined, and about 80 good sized pits, from  $\frac{1}{8}$  to  $\frac{3}{16}$  of an inch deep, were found, and 4 plaster casts were made as permanent records of some of the larger ones.

At an excavation about 25 feet south of the south track at the car house on Boylston Street was found the most serious damage that has thus far been discovered on any of the pipe lines. On the bottom and near the bell end of pipe No. 432 there are 5 large pits in an area of 4 square feet of pipe surface. The combined area of the pits is about  $1\frac{1}{2}$  square feet, and the iron was soft and disintegrated at these pits to a depth of from  $\frac{1}{2}$  of an inch to 1 inch. About 200 square feet of pipe surface were examined at this excavation, two-fifths of which had been covered with asphalt and burlap since December, 1902. This covering was removed and a few drops of moisture, sufficient to stain blotting paper, were found under it. Quite a number of fair sized pits were found in the pipe under the covering, but a complete record of the condition of the pipe when covered in 1902 was not made, so that the changes that have taken place under the coating cannot be determined. Casts were taken as records of several of the larger and deeper pits. The total number of separate and distinct pits was 150. They varied from  $\frac{1}{8}$  of an inch to 1 inch in depth, and the skin of the uncovered portion of the pipe was soft all over to about  $\frac{1}{8}$  of an inch in depth. After the examination of the pipe was completed the Boston Elevated Rail-



way Company recovered the portion which was formerly covered and painted the remainder of the pipe which had been exposed.

The insulating coating of asphalt and burlap was removed from pipe No. 780, under the car tracks opposite the car house on Boylston Street, and the pipe was carefully inspected. This pipe was discovered so badly pitted in December, 1902, when the insulating covering was first applied, that the 80 pits in it were carefully dug out and accurately located, and a plan of the outer surface was made for future reference. In April, 1904, the covering was removed from this pipe, and it was carefully examined, and the pits had then increased slightly in depth and considerably in area and number, as a total of 480 were located at that time. After the examination was completed, the Boston Elevated Railway Company recovered the pipe with asphalt and burlap. When examined during the past year the pipe was slightly damp in spots under the covering, and a total of 529 pits were found and accurately located. Of these, about 90 appeared to be new, and some of the old pits had enlarged in area, and in some cases 2 or more of the original pits had united to form a larger one. The depth of the old pits appeared to be only very slightly deeper than in 1904. Seven casts were taken as records of some of the larger and deeper pits, and are comparable with casts which were taken in 1904.

The examinations indicate that the portion of this 48-inch pipe line between Eliot Street in Cambridge and the south shore of the Charles River is in a dangerous condition.

An examination was made of about 150 square feet of pipe surface on the easterly 48-inch low-service pipe line in Middlesex Avenue at Eighth Street in Medford, just north of and on the positive side of an insulating joint located at this place. Thirty-four small pits and 2 distinct rings around the pipe were found, varying from  $\frac{1}{8}$  to  $\frac{3}{16}$  of an inch in depth, indicating that disintegration of the pipe is going on slowly on the positive section of the pipe line. Three casts were taken as permanent records.

An examination of the 42-inch low-service pipe line in Broadway at Second Street, Chelsea, showed that the pits found at this place in August, 1903, had enlarged in area and increased slightly in depth. Twenty pits were found, varying from  $\frac{1}{8}$  to  $\frac{3}{8}$  of an inch in depth, in an area of 50 square feet of pipe surface. Four casts were taken of the larger pits for comparison with casts made in

August, 1903. At the corner of Broadway and Williams Street about 150 square feet of pipe surface was examined on the 42-inch low-service main. The action at this point is quite uniform over the entire surface of the pipes. It was possible to cut into the pipe almost anywhere to a depth of  $\frac{1}{8}$  of an inch or more.

The 24-inch pipe in Broadway, south of Williams Street, is known to be in bad condition, but was not examined because it would have been necessary to disturb a new and expensive pavement which had been recently laid.

An examination was made of the 24-inch pipes crossing Chelsea Creek on December 18, and several casts were taken showing the condition of the pipes. The older pipe line is in a treacherous condition near low-water line, the material being very soft, so that it can readily be cut out to a depth of half an inch.

Measurements made during the year of the amount of electricity flowing on the pipes indicate that the disintegration of the 16-inch and 12-inch high-service pipe lines in Broad and Washington streets in Lynn is progressing at about the same rate as last year, but the pipes have not been examined because to do so it would have been necessary to disturb new and expensive pavements.

#### GYPSY AND BROWN-TAIL MOTHS.

The protection of the trees on the property of the Metropolitan Water Works from the ravages of the gypsy and brown-tail moths has required an expenditure of approximately \$10,700, which has been distributed as follows:—

Spot Pond, . . . . .	\$6,450
Chestnut Hill Reservoir, . . . . .	700
Weston Reservoir, . . . . .	1,300
Mystic Lake, pumping station and reservoir, . . . . .	300
Sudbury, Cochituate and Weston aqueducts, . . . . .	650
Lake Cochituate, . . . . .	590
Sudbury Reservoir, . . . . .	250
Reservoirs in Framingham, Ashland and Hopkinton, . . . . .	50
Wachusett Reservoir and Aqueduct, . . . . .	500
	<hr/>
	\$10,700

The cost of work done at Spot Pond was about \$4,000 less than during the previous year, and it was also less at Mystic Lake, reservoir and pumping station, but on other parts of the works there was

an increase in cost, due to the spread of moths and to an advance of from 10 to 12½ per cent. in the rate of wages.

In the vicinity of Boston natural causes have reduced the brown-tail moths to a very small percentage of the number which infested the trees two years ago, while in Framingham, Southborough and Clinton they have increased in numbers. The thorough work of destroying the gypsy moths which has been carried on during previous years on the property of the Board at Spot Pond, and on lands in Medford, Arlington and Somerville, has resulted in reducing the number of these moths to comparatively small numbers, and the reduction in cost in 1907 will be followed by a still further reduction during the coming year. There has, on the other hand, been a large increase in the number of gypsy moths in Newton, Weston, Natick and Framingham, through which the aqueducts pass. The cost of protecting the 220 acres at the Weston Reservoir, and along the Weston Aqueduct between the reservoir and the terminal chamber, was about \$1,300, or more than double the amount expended in 1906. No gypsy moths have been found on Water Works property west of Framingham, but 9,500 nests of the brown-tail moths were destroyed at the Sudbury Reservoir, and the nests have been destroyed in considerable and increasing numbers at the Hopkinton Reservoir, along the line of the Wachusett Aqueduct in Southborough and Northborough, and in Clinton in the vicinity of the Wachusett Reservoir.

The methods employed for destroying and preventing the spreading of the moths have been as follows:—

At Spot Pond the egg clusters of the gypsy moths were painted during the winter with a mixture of creosote and fuel oil. During the latter part of April and the early part of May, 1,900 pounds of tanglefoot were used in banding the trees, at a cost, including labor, of about \$675. Lines of boards set on edge and smeared with tanglefoot, which had proved very effective in 1906, were placed along the lines of adjoining property where the moths were very prevalent. During June and July the trees on 23 acres were sprayed with arsenate of lead. The trees on the ground at Mystic Lake, Mystic pumping station and reservoir, and at the Chestnut Hill and Weston reservoirs, were treated in a similar manner. Along the line of the aqueducts and at Lake Cochituate the egg clusters of the gypsy moths were painted with creosote, and at Lake Cochituate 5,700 trees were

banded with burlap. More than 20,000 caterpillars were destroyed along the lines of the aqueducts, at Lake Cochituate and the reservoirs in Framingham, Southborough and Clinton.

Considerable work has been done, particularly along the lines of the aqueducts, in cutting underbrush and undesirable trees, as experience has shown that the suppression of the gypsy moth is very difficult wherever there is a thick growth of underbrush, and the unnecessary trees afford lodging places for the moths and increase the cost of maintaining the works.

#### CLINTON SEWERAGE.

The Clinton sewage disposal works were in daily operation throughout the year. The quantity of sewage pumped on the filter-beds was 867,000 gallons per day, an increase of 72,000 gallons per day over the preceding year, and of 123,000 gallons per day over the average since the plant was put into operation in 1899. This increase was due to leakage of ground water into the sewers during the months of October, November and December, when the rainfall was abnormally large. The daily average quantity pumped during these months was 1,161,000 gallons, as compared with a daily average of 528,000 gallons during the month of August.

Following are statistics relating to the operation of the pumping station:—

Daily average quantity of sewage pumped (gallons),	. . .	867,000
Daily average quantity of coal consumed (pounds),	. . .	1,457
Gallons pumped per pound of coal,	. . . . .	595
Number of days pumping,	. . . . .	365
Cost of pumping:—		
Labor,	. . . . .	\$1,856 76
Fuel,	. . . . .	1,470 05
Repairs and small supplies,	. . . . .	1,252 95
Total for station,		\$4,579 76
Cost per million gallons pumped,	. . . . .	\$14 47
Cost per million gallons raised 1 foot high,	. . . . .	0 28

The cost of pumping was considerably in excess of that during any previous year, due to increased rate of wages, additional labor and fuel, due to shorter hours of labor and the larger quantity of sewage pumped, and to the cost of new pump plungers, diaphragms

and valves. Repairs were made to the chimney of the pumping station in May, consisting of pointing, painting and oiling the brickwork, cleaning and painting the cast-iron cap and cleaning the interior.

### *Filter-beds.*

The sewage was applied on the filter-beds in practically the same manner as during the preceding year until July 2, when, upon the recommendation of the Chief Engineer of the State Board of Health, radical changes were made in the method of applying the sewage, continuing to the end of the year.

The eight settling basins into which the sewage is pumped were used in rotation continuously throughout the year. During January, February and March the sewage was turned through one of the basins for two weeks, when it was drained off and another basin was used. During the remainder of the year, until December, two basins were used at a time for a period of one week, when they were drained and two others put into use; this method being adopted so as to decrease the velocity of the sewage while passing through the basins and thus increase the amount of sludge collected. During December two basins were used jointly for four weeks, then drained and two others put into use. By this method the eight basins can be used to care for the sludge during the winter, when it is impossible to clean them. The sludge accumulated in the settling basins has been given to the neighboring farmers, who are becoming from year to year more anxious to obtain this material for use on their farms.

Previous to April 19, at times when the temperature was below 15 degrees above zero, practically all of the sewage of each day's pumping was applied to one of five beds, which had been prepared with furrows 3 feet 6 inches apart, the average amount per application being 507,000 gallons, and each bed was used about once in nine days. When the temperature was higher than 15 degrees above zero the sewage was applied to the other or flat beds for about two and one-half hours, the amount per application being 313,000 gallons, and each bed was used about once in twelve and one-half days, which gives an average of about 25,000 gallons per acre per day. The amount of sewage applied to a bed at one time during this method of application varied with the severity of the winter from one and one-half hours to two and one-half hours. As the winter was very cold it was necessary when applying sewage to the flat beds to make the quantities large, in order to keep the beds open.



From April 19 to July 2 the sewage, after passing through the settling basins, was applied to one of twenty beds having an area of 1 acre for a little less than two hours, the amount of each application being about 215,000 gallons, and each bed was used about once in six days, the average rate being about 37,000 gallons per acre per day.

After July 2, when the recommendations of the Chief Engineer of the State Board of Health were put into effect, the sewage was applied to one of twenty beds having an area of 1 acre each for about thirty minutes, the time being so fixed as to use each bed every day, except as it had to be thrown out of service for weeding and cleaning. Under this method the amount per application was 64,000 gallons, and each bed was used about twice in three days, which gives an average of about 38,000 gallons per acre per day. At the beginning of freezing weather all of the twenty beds were prepared with furrows 3 feet 6 inches apart, and have been used on the half-hourly basis every day to the end of the year, without experiencing any trouble from freezing.

The results of the chemical analyses of the sewage and effluent are given in the following table:—

[Parts per 100,000.]

	1902.	1903.	1904.	1905.	1906.	January to June, 1907, inclusive.	July to December, 1907, inclusive.	Whole Year 1907.
Albuminoid ammonia, sewage.	1.0517	.9233	.7967	1.1250	.8558	1.0000	.6883	.8442
Albuminoid ammonia, effluent	.0891	.0782	.0686	.0787	.0955	.0975	.0513	.0744
Per cent. removed, . . .	89	92	91	93	89	90.3	92.5	91
Oxygen consumed, sewage,	8.85	8.65	8.57	13.11	9.84	9.39	6.35	7.87
Oxygen consumed, effluent,	1.15	1.12	.99	1.126	1.34	1.40	.73	1.07
Per cent removed, . . .	84	87	88	91	86	85.1	88.5	87
Free ammonia, sewage, . .	4.3284	3.8292	3.97	4.7533	3.5650	4.0550	3.6133	3.8342
Free ammonia, effluent, . .	.6862	1.0185	.99	.9588	1.2723	1.6483	.9868	1.3176
Per cent. removed, . . .	84	73	75	80	64	59.4	72.7	66
Nitrogen as nitrates, effluent,	.9815	.4168	.4046	.2665	.1445	.0565	.2763	.1664

The changes which have been made in the methods of applying the sewage have, to a slight degree, improved the character of the effluent, and it is expected that under the present system the beds will gradually improve in efficiency.

Under the direction of the Chief Engineer of the State Board of Health the experiments begun in 1906 have been continued, with a view to making further changes in the treatment of the sewage.

Devices for aerating the sewage as it leaves the settling basins have been placed in the outlet manholes. A wooden settling tank 2 feet deep, 12 feet wide and 42 feet long has been placed between the main effluent outlet and the small experimental filter, for the purpose of allowing the iron in the effluent to deposit in the tank before it reaches the experimental filter.

Six additional pipe wells have been placed over the filtering area for use in collecting samples of ground water, and 15 additional 2-inch tubular pipe wells have been driven for use in locating the water table in the filters and for collecting samples.

The small experimental filter, used for removing the iron from the effluent, was resurfaced twice with 6 inches of screened sand, and both the experimental filter and the settling tank have been covered so that they can be used during the winter.

The cost of maintaining the filter-beds, exclusive of the cost of the experimental work, which amounted to \$502.81, has been as follows:—

Labor, . . . . .	\$3,020 78
Repairs and supplies, . . . . .	34 40
Total, . . . . .	<hr/> \$3,055 18
Cost per million gallons treated, . . . . .	\$9 77

The cost of maintaining the beds has been considerably in excess of that of previous years, due to the increased rate of wages and changes in the method of operation.

Daily tests of the sewage and effluent, to determine the amount of dissolved oxygen and iron, have been made by the keeper in charge of the beds.

#### ENGINEERING.

A very large portion of the time of the engineering force is now devoted to matters pertaining to the maintenance and operation of the works. The more important of these matters are the superintendence of the operation of the Venturi meters and of the flow of water from the several reservoirs through the aqueducts; the determination of the quantities of water used in the several municipali-

ties; the tabulation of the records of rainfall as measured at twelve stations on the works, of the elevations of the several storage and distributing reservoirs, and of the pressures in the mains at different points in the Metropolitan District; the making of calculations to determine the yield of the several watersheds, the quantities delivered by the several aqueducts, the quantities pumped at the several pumping stations and the cost of pumping; the testing of coal and oil; and the examination of the pipes to determine the injury from electrolytic action.

Appended to this report are tables of contracts giving the amount of work done and other information, a long series of tables relating to the maintenance of the Metropolitan Water Works, tables showing the length of main pipes and number of service pipes, meters and fire hydrants in the Metropolitan Water District, and a summary of statistics for 1907.

Respectfully submitted,

DEXTER BRACKETT,

*Chief Engineer.*

Boston, January 1, 1908.

## REPORT OF CHIEF ENGINEER OF SEWERAGE WORKS.

---

*To the Metropolitan Water and Sewerage Board.*

GENTLEMEN:—The following is a report of the operations of the Engineering Department of the Metropolitan Sewerage Works for the year ending December 31, 1907.

### ORGANIZATION.

The engineering organization during the year has been as follows:—

#### *Division Engineers:—*

FREDERICK D. SMITH, . . . *In charge of maintenance and construction, South Metropolitan System, in Quincy and Milton.*

FRANK I. CAPEN, . . . *In charge of maintenance and construction, North Metropolitan System and extension of the High-level Sewer in Brookline and Brighton.*

SETH PETERSON, . . . *In charge of construction, Section 80, including air tunnel, and of Section 81, South Metropolitan System.*

In addition to the above, there were employed at the end of the year 24 engineering and other assistants.

## METROPOLITAN SEWERAGE DISTRICTS.

## AREAS AND POPULATIONS.

During the year no changes have been made in the extent of the sewerage districts. The area of the North Metropolitan District remains at 90.50 square miles, and of the South Metropolitan District at 100.87 square miles, — a total, inclusive of water surfaces, of 191.37 square miles. These districts include the whole or parts of 25 cities and towns, as set forth in the following table.

The populations in the table are based on the census of 1905.

*Table showing Areas and Estimated Populations within the Metropolitan Sewerage District, as of December 31, 1907.*

	CITY OR TOWN.	Area (Square Miles).	Estimated Population.
North Metropolitan District.	Arlington, . . . . .	5.20	10,340
	Belmont, . . . . .	4.66	4,630
	Boston (portions of), . . . . .	3.45	95,210
	Cambridge, . . . . .	6.11	100,740
	Chelsea, . . . . .	2.24	38,940
	Everett, . . . . .	3.34	31,840
	Lexington, <sup>1</sup> . . . . .	5.11	5,010
	Malden, . . . . .	5.07	40,200
	Medford, . . . . .	5.35	20,990
	Melrose, . . . . .	3.73	14,990
	Revere, . . . . .	5.86	14,010
	Somerville, . . . . .	3.96	73,280
	Stoneham, . . . . .	5.50	6,570
	Wakefield, . . . . .	7.65	10,850
	Winchester, . . . . .	5.95	8,850
South Metropolitan District.	Winthrop, . . . . .	1.61	7,720
	Woburn, . . . . .	12.71	14,470
		90.50	498,640
	Boston (portions of), . . . . .	20.39	161,050
	Brookline, . . . . .	6.81	25,280
	Dedham, <sup>1</sup> . . . . .	9.40	7,880
	Hyde Park, . . . . .	4.57	15,080
	Milton, . . . . .	12.59	7,440
	Newton, . . . . .	16.88	38,660
	Quincy, . . . . .	12.56	29,890
	Waltham, . . . . .	13.63	27,720
	Watertown, . . . . .	4.04	12,090
		100.87	325,090
Totals, . . . . .		191.37	823,730

<sup>1</sup> Part of town.



## METROPOLITAN SEWERS.

## SEWERS PURCHASED AND CONSTRUCTED AND THEIR CONNECTIONS.

Within the Sewerage Districts there are now 98.8 miles of Metropolitan sewers. Of this total, 8.79 miles of sewers, with the Quincy pumping station, have been purchased from cities and towns of the districts, the remaining 90 miles of Metropolitan sewers and other works having been constructed by the Metropolitan boards.

The position, lengths and sizes of these sewers are given in the following tables, together with other data referring to the public and special connections with the system:—

*North Metropolitan System.*

CITY OR TOWN.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1907.	SPECIAL CONNECTIONS.	
				Character or Location of Connection.	Number in Operation.
Boston:—					
Deer Island, .	6' 3" to 9', . . . . .	1.367	4	Shoe factory, . . . . .	1
East Boston, .	9' to 1', . . . . .	5.467	23	Navy Yard, . . . . .	3
Charlestown, .	6' 7"×9' 5" to 1', . . . . .	3.292	13	Alms-house, . . . . .	1
Winthrop, .	9', . . . . .	2.864	8	Club house, . . . . .	1
				Fire Dept. Station, . . . . .	1
				Bakery, . . . . .	1
Chelsea, .	8' 4"×9' 2" to 1' 10"×2' 4", .	5.123	9	Rendering works, . . . . .	1
				Metropolitan Water Works blow-off, . . . . .	1
Everett, .	8' 2"×8' 10" to 4' 8"×5' 1", .	2.925	6	Metropolitan Water Works blow-off, . . . . .	1
				Cameron Appliance Co., . . . . .	1
Malden, .	4' 6"×4' 10" to 1' 3", . . . . .	4.493 <sup>1</sup>	26	Shultz-Goodwin Co., . . . . .	1
				Metropolitan Water Works blow-off, . . . . .	1
Melrose, .	4' 6"×4' 10" to 10", . . . . .	6.099 <sup>2</sup>	34	Private buildings, . . . . .	129
				Private buildings, . . . . .	107
Cambridge, .	5' 2"×5' 9" to 1' 3", . . . . .	7.167	30	Factory, . . . . .	1
				Railroad station, . . . . .	1
				Slaughter-house, . . . . .	1
				City Hospital, . . . . .	1
				Tannery, . . . . .	1
Somerville, .	6' 5"×7' 2" to 1' 10"×2' 3", .	3.471	10	Slaughter-houses (3), . . . . .	1
				Car-house, . . . . .	1
				Street railway power house, . . . . .	1
				Stable, . . . . .	1
Medford, .	4' 8"×5' 1" to 10", . . . . .	5.359	20	Rendering works, . . . . .	1
				Armory building, . . . . .	1
				Private buildings, . . . . .	7
				Stable, . . . . .	1
Winchester, .	2' 11"×3' 3" to 1' 3", . . . . .	6.428	13	Tannery, . . . . .	2
				Private buildings, . . . . .	2
				Gelatine factory, . . . . .	1
Stoneham, .	1' 3" to 10", . . . . .	0.010	4	Stable, . . . . .	1
Woburn, .	1' 10"×2' 4" to 1' 3", . . . . .	0.933	3	Railroad station, . . . . .	1
Arlington, .	1' 6" to 10", . . . . .	3.520 <sup>3</sup>	33	Glue factory, . . . . .	1
				Private buildings, . . . . .	110
				Railroad station, . . . . .	1
				Car-house, . . . . .	3

<sup>1</sup> Includes .988 of a mile of sewer purchased from the city of Malden.

<sup>2</sup> Includes .736 of a mile of sewer purchased from the city of Melrose.

<sup>3</sup> Includes 2.631 miles of sewer purchased from the town of Arlington.

*North Metropolitan System — Concluded.*

CITY OR TOWN.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1907.	SPECIAL CONNECTIONS.	
				Character or Location of Connection.	Number in Operation.
Belmont, <sup>1</sup> . . . . .	- . . . .	-	3	- . . . .	-
Wakefield, <sup>1</sup> . . . . .	- . . . .	-	1	- . . . .	-
Revere, . . . . .	4' to 3', . . . . .	0.048	2	- . . . .	-
		58.566 <sup>2</sup>	242		396

*South Metropolitan System.*

Boston (Back Bay),	6' 6" to 3' 9", . . . . .	1.500 <sup>3</sup>	9	{ Private house, . . . . . Administration building, Boston Park Department, Simmons College buildings, . . Art Museum, . . . . .	1 1 1 2
Boston (Brighton),	5' 9"×6' 0" to 12", . . . . .	4.118 <sup>4</sup>	11	{ Abattoir, . . . . . Chocolate works, . . . . . Machine shop, . . . . . Paper mill, . . . . .	3 2 1 1
Boston (Dorchester). Boston (Roxbury),	3'×4' to 2' 6"×2' 7", . . . . . 6' 6"×7', 4' 0", . . . . .	2.870 <sup>5</sup> 1.430	8 -	{ Private buildings, . . . . . - . . . .	2 -
Boston (West Roxbury). Brookline, . . . . .	9' 3"×10' 2" to 12", . . . . . 6' 6"×7' 0" to 5' 6", . . . . .	7.427 1.435	9 2	{ Parental school, . . . . . Lutheran Evangelical Church, Private buildings, . . . . .	1 1 4
Dedham, . . . . .	4'×4' 1" to 3' 9"×3' 10", . . . . .	2.350	5	- . . . .	-
Hull, . . . . .	60" pipe, . . . . .	0.750	-	- . . . .	-
Hyde Park, . . . . .	10' 7"×11' 7" to 4'×4' 1", . . . . .	4.527	15	{ Mattapan Paper Mills, . . . . . Private buildings, . . . . .	1 2
Milton, . . . . .	11'×12' to 8", . . . . .	3.600	9	- . . . .	-
Newton, . . . . .	4' 2"×4' 9" to 1' 3", . . . . .	2.911	6	Private houses, . . . . .	2
Quincy, . . . . .	11' 3"×12' 6" to 24" pipe, . . . . .	6.580	4	- . . . .	-
Waltham, . . . . .	3' 6"×4', . . . . .	0.001	1	- . . . .	-
Watertown, . . . . .	4' 2"×4' 9" to 12", . . . . .	0.750 <sup>6</sup>	5	Factories, . . . . .	2
		40.249	84		27

<sup>1</sup> The Metropolitan sewer extends but a few feet into the towns of Belmont and Wakefield.

<sup>2</sup> Includes 2.787 miles of Mystic River valley sewer in Medford, Winchester and Woburn, running parallel with the Metropolitan sewer.

<sup>3</sup> Includes .355 of a mile of sewer purchased from the city of Boston.

<sup>4</sup> Includes .026 of a mile of sewer purchased from the town of Watertown.

<sup>5</sup> Includes 1.24 miles of sewer purchased from the city of Boston.

<sup>6</sup> Includes .025 of a mile of sewer purchased from the town of Watertown.

## COST OF CONSTRUCTION.

[To December 31, 1907.]

The cost of the 98.8 miles of Metropolitan sewers enumerated above, including seven stations, siphons and appertaining structures, may be summarized as follows: —

North Metropolitan System, . . . . .	\$6,146,023 16
South Metropolitan System, . . . . .	8,182,571 79
	<hr/> \$14,328,594 95

Information relating to areas, populations, local sewer connections and other data for the whole Metropolitan Sewerage District appear in the following table: —

*North Metropolitan District.*

Area (Square Miles).	Estimated Total Population.	Miles of Local Sewer connected.	Estimated Population contributing Sewage.	Ratio of Contributing Population to Total Population (Per Cent.).	CONNECTIONS MADE WITH METRO- POLITAN SEWERS.	
					Public.	Special.
90.50	498,640	624.74	422,065	84.6	242	396

*South Metropolitan District.*

100.87	325,090	479.51	188,150	57.9	84	27
--------	---------	--------	---------	------	----	----

*Entire Metropolitan District.*

191.37	823,730	1,104.25	610,215	74.1	326	423
--------	---------	----------	---------	------	-----	-----

Of the estimated gross population of 823,730 on December 31, 1907, 610,215, representing 74.1 per cent., were on that date contributing sewage to the Metropolitan sewers, through a total length of 1,104.25 miles of local sewers owned by the individual municipalities. These sewers are connected with the Metropolitan System by 326 public and 423 special connections. It appears, also, that there has been during the year an increase of 42.19 miles of local sewers connected with the Metropolitan System, and that 7 public and 16 special connections have been added.

PUMPING STATIONS AND PUMPAGE.

The following table shows the average daily volume of sewage lifted at each of the six Metropolitan pumping stations during the year, as compared with the corresponding volumes for the previous year: —

PUMPING STATION.	AVERAGE DAILY PUMPAGE.			
	Jan. 1, 1906, to Dec. 31, 1906.	Jan. 1, 1907, to Dec. 31, 1907.	Increase during the Year.	
	Gallons.	Gallons.	Gallons.	Per Cent.
Deer Island, . . . . .	58,100,000	64,300,000	6,200,000	10.7
East Boston, . . . . .	56,100,000	62,300,000	6,200,000	11.1
Charlestown, . . . . .	30,500,000	32,600,000	2,100,000	6.9
Alewife Brook, . . . . .	3,451,000	4,123,000	672,000	19.5
Quincy, . . . . .	3,528,000	3,615,000	87,000	2.5
Ward Street (actual gallons pumped), .	20,800,000	21,200,000	400,000	1.9

## CONSTRUCTION.

### NORTH METROPOLITAN SYSTEM.

EXTENSION OF THE METROPOLITAN SEWER IN THE CITY OF MALDEN,  
(AUTHORIZED BY CHAPTER 319 OF THE LEGISLATIVE ACTS OF  
1906).

#### *Section 64, Malden Extension.*

*Division Engineer in Charge.* — FRANK I. CAPEN.

*Contractor.* — T. H. GILL & Co.

At the beginning of the year the work was practically completed, as noted in the last annual report, except for minor repairs to surfaces in private lands and resurfacing of streets.

Sewage was turned into the section January 5, 1907, and since that date it has been in use as part of the North System.

About May 1, the necessary repairs were made over the line of the sewer in private lands, and the streets resurfaced and paved.

### TIMBER BULKHEAD IN CHELSEA CREEK.

During the year a timber bulkhead has been constructed on the bulkhead lines of Chelsea Creek, at the northerly side of a lot on Chelsea Street near the Chelsea Street Bridge, East Boston, owned by the Commonwealth and occupied since its purchase as a site for locker and stable buildings for the North Metropolitan maintenance uses.

The lot as acquired included 52,000 square feet to the pier-head line of Chelsea Creek, as established by the United States Govern-

ment. Of this amount all but about 10,000 square feet was in tidal flats. The bulkhead as constructed encloses most of the flats. The lot when filled to the limits of the bulkhead will have an area of 38,600 square feet.

Permission for the construction of this bulkhead was granted by the Harbor and Land Commission May 17, 1907, under license No. 3172, and by the United States Government June 1. A contract for building this was made with Lawler Brothers July 16, 1907. Work was begun August 5, and completed September 3.

The bulkhead is of 4-inch hard pine, driven about 4 feet into the hard clay bottom of the creek, with spruce piles and spur shores, spaced 6 feet on centres.

The top of the bulkhead is about 6 feet above high water of the creek. The total length of bulkhead constructed was 359 feet. The tidal flats now enclosed by the bulkhead are being filled with ashes from the Metropolitan pumping stations and waste material deposited by the Boston street department. Approximately one-third the enclosed area is now filled to about the elevation of nearby streets.

### **SOUTH METROPOLITAN SYSTEM.**

#### **EXTENSION OF THE HIGH-LEVEL SEWER THROUGH WEST ROXBURY, BROOKLINE AND BRIGHTON.**

This extension, authorized by chapter 406 of the legislative Acts of 1906, involves a length of 5.64 miles of main sewers, varying from 7 feet in diameter to 5 feet in diameter, and extending from Jamaica Plain, in West Roxbury, through Brookline and Brighton to Oak Square in Brighton, as outlined in detail in the last annual report.

For convenience in arranging contracts and records, this length has been divided into sections, numbered from 80 to 86, inclusive.

At the date of the last report construction was in progress on Section 80, located in West Roxbury. On account of its peculiarly dangerous character, construction on this section is being carried on by the Board by day labor, under direction of the Engineer.

During the year construction by contracts and day labor through West Roxbury, Brookline and Brighton, to within 2,500 feet of Oak Square, has been in progress, involving what has been known as Sections 80 to 85, inclusive.



ARTHUR D. BUZBY, C. E.



METHOD OF SUPPORTING ROOF PLATES IN TUNNEL HEADING—CONSTRUCTION BY COMPRESSED AIR ON HIGH LEVEL SEWER EXTENSION.



To date, 2.24 miles of this extension have been completed, and the sections now completed and under contract provide for about 4.25 miles. Section 86, near Oak Square, Brighton, it is anticipated will be placed under contract early in the coming spring.

*Section 80, West Roxbury and Brookline.*

*Division Engineer in Charge.* — SETH PETERSON.

*Superintendent of Construction by Day Labor.* — CHARLES A. HASKIN.

This section extends from a branch in the existing bellmouth at the corner of Perkins and Day streets, along Perkins and Chestnut streets, in West Roxbury, passing Jamaica Pond, to a point in Chestnut Street about 15 feet beyond the Brookline town line, — a length of 3,123 feet.

The section is wholly in tunnel, at depths varying from 70 feet to 20 feet below the street surfaces. Passing Jamaica Pond the excavation is 35 feet below the ordinary water surface of the pond.

Owing to the peculiarly dangerous character of the work, it is being constructed by the Board by day labor and by pneumatic process, under the direction of Charles A. Haskin, pneumatic expert.

At the date of the last report a shaft leading down to the tunnel had been completed at a point 475 feet east of Jamaica Parkway, and tunnel headings had advanced about 70 feet both east and west from this shaft.

At the date of this report the east heading has advanced 1,230 feet from the shaft, and is now about 100 feet from the bellmouth at Center Street, which is to be the end of the section.

An air pressure from 6 to 8 pounds per square inch in excess of the atmospheric pressure has been maintained in this heading. For 600 feet the excavation has been in sand, gravel, quicksand and clay, with occasional boulders and short lengths of ledge. At this distance from the shaft solid ledge appeared in the bottom of the headings, and for a length of 150 feet the tunnel heading advanced into the sloping face of the ledge. At the distance of 800 feet from the shaft the excavation was in solid ledge of Roxbury pudding-stone, and has so continued for 425 feet, and will, doubtless, so continue to the end.

It is estimated the excavation will be completed in this heading about the middle of February, 1908.

To minimize the shocks from blasts on buildings near the line of the tunnel, the air pressure has been maintained in the heading while rock excavation has been in progress.

The average progress of the excavation has been 22 feet per week; the maximum progress of the excavation has been 41 feet per week; the average diameter of rock tunnel has been 10 feet.

The masonry lining of the tunnel has been completed in this heading to a point 885 feet from the shaft. The completed sewer is 7 feet in diameter, of circular cross-section, with not less than 12 inches in thickness of Portland brick walls.

In the solid ledge the masonry lining has not been placed. It is anticipated that this will be of concrete and will be completed as early as May 1, 1908.

The westerly heading has advanced at the date of this report 1,330 feet from the shaft, and about 520 feet remain to be completed. It is probable that this will be completed as early as May 1, 1908. The excavation has been through fine sand, coarse gravel and quicksand, in alternate layers, with occasional boulders. An air pressure of about 6 pounds per square inch in excess of atmospheric pressure was maintained in this heading near the shaft, gradually increasing to 12 pounds near Jamaica Pond at the end of the year. Average progress of excavation, 24 feet per week; maximum progress of excavation, 42 feet per week.

The masonry lining in this heading has been completed to the end of the heading. The sewer is 7 feet in diameter, with not less than 12-inch Portland brick walls.

The total weekly progress for the whole section has been: average per week, 46 feet; maximum per week, 83 feet.

### *Section 81, Brookline.*

*Division Engineer in Charge.* — SETH PETERSON.

*Contractors.* — BRUNO & PETITTI, Contract No. 60 (Sta. 0 to 21 + 40). HUGH NAWN CONTRACTING COMPANY, Contract No. 61 (Sta. 21 + 40 to 34 + 15).

This section extends from near the town boundary line of Brookline, at Chestnut Street, along Chestnut, Kendall and Cypress streets, to Boylston Street in Brookline, — a distance of 3,415 feet.

Two contracts have been made for this construction, one extending from the town line along Chestnut and Kendall streets, a distance of 2,140 feet, with Bruno & Petitti. The sewer for this length is lo-



AIR LOCK AT TUNNEL HEADING CONSTRUCTION BY COMPRESSED AIR ON HIGH LEVEL SEWER EXTENSION.





cated about 20 feet to its water line below the street surface. The excavation is expected to be largely in sand, gravel and clay, with considerable water.

The contract was made November 27, 1907. On account of the severe weather of the winter, the Board permitted the contractor to delay starting on this work until March 1, 1908.

A second contract, extending from Kendall Street, through Cypress Street, to Boylston Street, a distance of 1,275 feet, was made with the Hugh Nawn Contracting Company on November 25, 1907. Of this length, 940 feet will be in tunnel, in earth and Roxbury pudding-stone, and 335 feet in open trench. Work in the open cut section was started December 2, 1907, on the south side of Boylston Street. At the date of this report 130 feet of trench have been excavated to grade. The excavation at this location has a depth of about 25 feet, — 20 feet in sand, gravel and clay. The bottom 5 feet is in Roxbury pudding-stone. The excavation has been handled by bucket excavators. Considerable water has been found in excavation.

A shaft about 12 feet square for tunnel heading was started December 5, 1907, at the corner of Kendall and Cypress streets. At the date of this report the shaft has been completed to a depth of about 35 feet, and a tunnel heading started in a northerly direction.

The sewer along the whole length of this section is to be of horse-shoe cross-section, 7 feet high and 6 feet 6 inches wide. The masonry walls of the sewer are to be of Portland concrete, from 12 inches to 15 inches in thickness. At the date of this report no masonry has been placed in the section.

### *Section 82, Brookline.*

*Division Engineer in Charge.* — FRANK I. CAPEN.

*Contractors.* — T. J. O'CONNELL, Contract No. 57 (Sta. 0 + 30 to 13 + 50).

T. J. O'CONNELL, Contract No. 55 (Sta. 30 + 50 to 48 + 50). JAMES

DRISCOLL & SON, Contract No. 56 (Sta. 13 + 50 to 30 + 50).

This section extends from Boylston Street, along Cypress Street, Brington Road, private lands, Brookline Playground, Davis and Gorham avenues, Greenough, Washington and Park streets, to Beacon Street, — a distance of 4,830 feet.

Three contracts have been made for this construction; one extending from Boylston Street to Davis Avenue, with T. J. O'Connell, dated July 9, 1907, for a length of 1,320 feet. Work on this con-

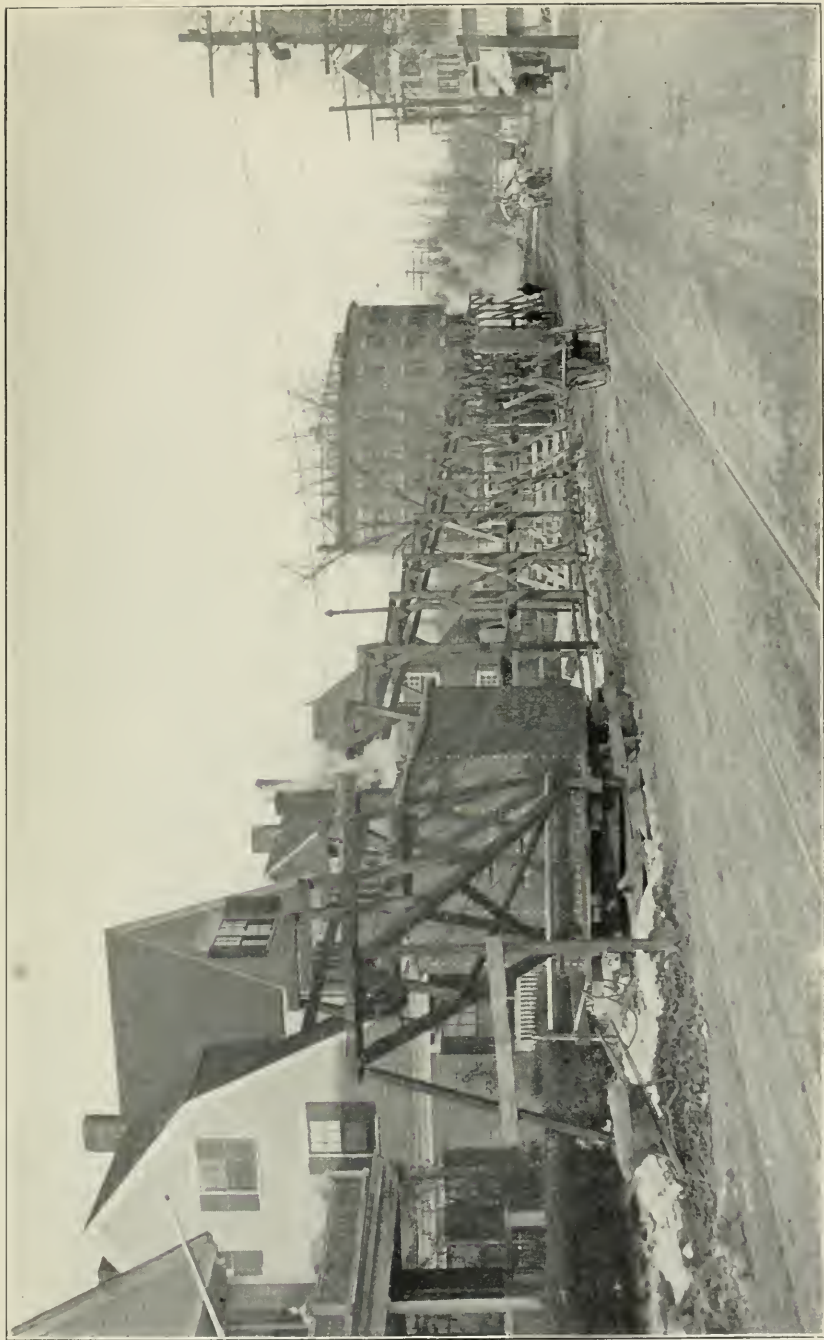
tract was begun July 18, at Davis Avenue. The excavation had an average depth of 18 feet, in sand, gravel and clay. In the Brookline Playground, for a length of about 200 feet, very fine sand was encountered. Not a large amount of water was found in the excavation. It was handled by a 4-inch centrifugal pump, electrically operated at a well on Davis Avenue. This pump controlled the ground waters to the crossing of the Boston & Albany Railroad. The excavation was handled by bucket excavators from Davis Avenue to the railroad. The excavation under the railroad and Village Brook was made without the aid of machinery. Through private lands and Brington Road the excavation was handled by bucket excavators, to near Cypress Street. In Cypress Street and for a short length in Brington Road, Roxbury pudding-stone was found for a depth of about 6 feet at the bottom of the trench. This rock excavation was found for a length of about 150 feet, and over this length of trench the excavation was handled by a framed derrick on platform.

No large amount of water was found in the excavation between Boylston Street and the railroad. It was handled from a well on private lands near Brington Road by a 4-inch centrifugal pump, electrically operated. The excavation on this length of the section was completed about the middle of December.

The sewer for this length is 6 feet 6 inches wide and 7 feet high, of horseshoe cross-section. It is built of Portland concrete, with walls about 12 inches in thickness. Passing under the branch of the Boston & Albany Railroad the masonry was increased to about 16 inches in thickness and reinforced with twisted steel. Passing under Village Brook the section was widened to 8 feet and the arch depressed so that the sewer had a height of 5 feet and 6 inches. The walls of the sewer were increased to 16 inches in thickness and the section reinforced with twisted steel.

For a length of about 100 feet, in Brington Road, the local 8-inch sewer was relaid on the side of the Metropolitan Sewer. The masonry was completed on this contract and trenches backfilled late in December. On account of the severe winter conditions, repairs to surfaces of streets and in private lands will be made in the spring.

A second contract, for construction of part of this section, was made with James Driscoll & Son, on May 21, 1907, for a length of 1,700 feet, in Gorham Avenue, Greenough and Washington streets,



TRENCH MACHINE IN OPERATION ON CYPRESS STREET, BROOKLINE—HIGH LEVEL SEWER EXTENSION.





from Davis Avenue to Park Street. Work on this contract was begun June 4, 1907, at Davis Avenue. The excavation had an average depth of 22 feet, with a maximum of 26 feet in Greenough Street. For a length of about 400 feet in Greenough Street the excavation was in hard, compact gravel and clay. On the remainder of the contract the excavation was in clean sand and gravel of such character that it was used in the masonry of the sewer. But very little water was found anywhere in the section; such as was found was handled in a well at Davis Avenue, and lifted by a 4-inch centrifugal pump, electrically operated, the same as used by T. J. O'Connell, before noted. The excavation throughout practically the whole contract was carried out by bucket excavators. The excavation was completed about December 1. For a length of 30 feet near the corner of Greenough Street and Gorham Avenue, passing an elm tree of great size, the excavation was in tunnel.

The sewer for the 1,700 feet of this contract is of horseshoe cross-section, 6 feet 6 inches wide and 7 feet high. The invert is built entirely of Portland concrete, with walls about 12 inches in thickness. The arch is of Portland brickwork, 8 inches thick, reinforced with concrete spandrels for about three-fourths its height. Passing under a brick sewer of the town of Brookline, at the corner of Washington and Park streets, the masonry section of the sewer was increased to 8 feet in width and the arch depressed to 5 feet and 6 inches in height. The walls of the concrete invert in the modified section were about 16 inches in thickness and the brick arch 12 inches. This section was further reinforced with twisted steel rods.

Work on this contract was completed at the date of this report, except for repairs to street surfaces and sidewalks, which, owing to frozen winter conditions, will be delayed until spring.

A third contract for construction on this section was made with T. J. O'Connell on May 29, 1907, for a length of about 1,800 feet in Park Street, from Washington Street to Beacon Street. Work on this contract was begun June 8. The excavation was in dry sand and gravel, with an average depth of 24 feet and a maximum depth of 28 feet near Beacon Street. The excavated material was of such character that it was used in the masonry of the sewer. The excavation was handled for practically the whole contract by bucket excavators of the cableway type. The excavation was practically dry.

The underdrain under the sewer was connected with a deep drain of the town of Brookline, near Washington Street, thus avoiding any lifting of ground waters by the contractors.

The sewer for the whole length of this contract is 6 feet 3 inches wide and 6 feet 6 inches in height, of horseshoe cross-section. The invert is of Portland concrete, with walls about 12 inches in thickness. The arch is of Portland brickwork, 8 inches thick, reinforced with concrete spandrel walls for about three-fourths its height.

The excavation on the contract was completed December 7, and December 26 the contract was completed, except for minor repairs to street surfaces and sidewalks that the winter conditions will delay until spring.

Quite an extensive caving in of the trench occurred at a point about 30 feet north of Marion Street. On August 12, about 6 P.M., 40 feet of this trench collapsed, carrying with it the local sewer, water pipe and gas pipe, and settling the street from curb to curb. Nobody was injured and the damage to local pipes was not extensive.

*Day Work, passing Town Sewer in Park Vale, between Station 31  
+01 and 31+16.*

Crossing Park Street, at Park Vale, the town of Brookline has a storm sewer 4 feet 6 inches in diameter. This drains a large and important area of the town. The Metropolitan Sewer in Park Street, part of Section 82, crosses this sewer. The construction was such as to require important modification of a short length of the town sewer. It was found advisable to construct by day labor a length of 15 feet of the Metropolitan Sewer passing this town sewer. Work was begun April 11, 1907, and completed June 12. A length of 18 feet of this storm sewer was removed and two 10-foot lengths of 36-inch cast-iron water pipe substituted, with concrete reducing sections at the ends of the pipes, connecting them to existing construction.

This permitted the standard 6 foot 3 inch by 6 foot 6 inch Metropolitan Sewer of horseshoe cross-section to be constructed over the town drain.

The invert of the Metropolitan Sewer for this length has 12-inch Portland concrete walls, lined with 4-inch Portland brickwork. The arch is of 8-inch Portland brickwork, reinforced to about three-fourths of its height with concrete spandrel walls. The 36-inch water pipes

are embedded in a mass of concrete extending about 6 inches outside the pipes.

At the request of the Town Engineer of Brookline, a 12-inch pipe sewer about 18 feet in length was laid parallel to the storm drain on its northerly side, and at a depth of 2 feet below it, to provide for future local drainage. Manholes were built upon either side of the Metropolitan Sewer, giving access to the storm sewer for purposes of inspection and maintenance.

*Change of Water Pipe in Park Street, made Necessary by the Construction of Section 82 of the High-level Sewer.*

The High-level Sewer in Park Street is located on the westerly side of the street about 4 feet from the curb line. The street for its entire length contains a 24-inch water main, a 15-inch local sewer, a 6-inch water pipe and a 4-inch gas pipe. The location selected for the Metropolitan Sewer was obstructed by a 6-inch water pipe which supplied Park Street and the adjacent district. It was deemed advisable to relocate the water pipe on the easterly side of the street to avoid possible damage to it during the construction of the sewer.

On January 18, 1907, an agreement was made by the Board with the Superintendent of Water Works of the town of Brookline to place a new 6-inch water pipe in the street and to make the necessary changes in the house connections and fire service. The work involved about 1,800 feet of pipe; it was begun on March 30, 1907, and completed on June 1, before the contract for the High-level Sewer in Park Street was awarded.

The old pipe taken out during the construction of the sewer has been stored on the Ward Street pumping station lot.

*Section 83, Brookline.*

*Division Engineer in Charge.* — FRANK I. CAPEN.

*Contractors.* — CHARLES G. CRAIB & Co., Contract No. 54 (Sta. 16 + 64 to 24 + 64). T. J. O'CONNELL, Contract No. 62 (Sta. 0 to 16 + 64).

This section extends through Winchester Street and private lands, from Beacon Street, to near Columbia Street, — a total distance of 2,464 feet. It is wholly in tunnel, at depths ranging from 30 feet to 50 feet below the surface.

Two contracts have been arranged for this construction, one with Charles G. Craib & Co., dated April 10, 1907, for a length of 800 feet, extending from a point on Winchester Street, near Fuller Street,

westerly through Winchester Street, beyond Thorndike Street, thence in private land to a point near Columbia Street. Work on this section was begun April 23, 1907, at a shaft about 12 feet square, in private land near Columbia Street, 23 feet from the end of the section.

The excavation of this shaft was about 30 feet in depth, in sand, gravel and clay, and was completed May 11, 1907. Headings were started from this shaft in an easterly direction towards Columbia Street May 13, and completed May 17.

A heading was started in a westerly direction towards Winchester Street May 20, 1907, and extended to a point 327 feet beyond the shaft. This heading was completed September 3.

A second shaft, about 12 feet square, located on Winchester Street, about 45 feet north of Fuller Street, was started April 29, 1907. The excavation was in sand, gravel and clay to a depth of 45 feet, and was completed May 15.

A heading extending northerly along Winchester Street from this shaft was started May 30, 1907, and was completed to a point 406 feet from this shaft on August 13. A heading south from this shaft was started September 16 and extended to a point 33 feet from the shaft on September 19.

The excavation in the tunnel heading was in sand, gravel and clay, with a small amount of water, lifted by 2-inch piston pumps in the shafts. The excavated material was lifted by small derricks at the shafts.

For a length of 200 feet, about midway between the shafts, boulders of large size were encountered in the headings. The tunnel heading was about 9 feet high and 9 feet in width, involving about 3 cubic yards of excavation per linear foot. The headings were sheathed with 2-inch lagging, with posts and caps 4 feet 6 inches apart.

The completed sewer is 5 feet 9 inches wide and 6 feet in height. The masonry walls of the sewer are of concrete and the tunnel headings, as outlined above, are of such dimensions as to yield not less than 12 inches of concrete at any point.

The placing of this concrete began July 3, 1907, and was completed November 15. The shaft near Fuller Street has not been filled to date but is still in use by other contractors on other portions of the section. The shaft on private lands near Columbia

Street was filled about December 1. The masonry of the sewer was built across the shaft, and the arch reinforced to a depth of about 3 feet with concrete.

A second contract for a portion of this section in Beacon and Winchester streets, between Park Street and Fuller Street, was made with T. J. O'Connell November 26, 1907, for a length of 1,664 feet. A shaft in Beacon Street, at the end of the section, about 12 feet square, for tunnel heading, was started December 4, and completed December 9, to a depth of about 30 feet. A tunnel heading was started in a northerly direction December 10. At the date of this report about 66 feet have been excavated in dry sand and gravel.

A shaft in Winchester Street, about 800 feet north of Beacon Street, was started December 5, 1907, and completed December 17, to a depth of about 32 feet; the shaft is 12 feet wide and about 16 feet in length.

A heading northerly from the shaft was started December 19, 1907, and at the date of this report has advanced about 30 feet. A southerly heading was started December 19, and driven about 30 feet at the date of this report. The excavated material in both headings was sand and clay with considerable water. Work was begun December 4 on the extension of the heading southerly from a shaft near Fuller Street, left by Charles G. Craib & Co., before noted. About 25 feet of excavation have been completed in the heading in sand and clay. A small amount of water has been found in the heading. The headings are about 9 feet high and 9 feet wide, sheathed with 2-inch plank, with posts and caps about 4 feet 6 inches apart. About 50 feet of the masonry lining of the tunnel have been placed.

The completed sewer is 6 feet high and 5 feet 9 inches wide; the masonry is of Portland concrete and the walls are not less than 12 inches in thickness.

*Section 84, Brookline and Brighton.*

*Division Engineer in Charge.* — FRANK I. CAPEN.

*Contractor.* — D. F. O'CONNELL, Contract No. 53.

This section extends from near Winchester Street, through private lands and Columbia Street in Brookline, and in Harlan Street, private lands and Commonwealth Avenue in Brighton, to near Allston Street, — a distance of 2,168 feet.

The contract for the construction was made with D. F. O'Connell,



dated April 9, 1907. Work on the contract was begun April 23, in private land near Columbia Street. The excavation had an average depth of 16 feet, largely in sand, gravel and clay. Between Station 3+01 and Station 6+15, passing a pocket of peat, the sewer was supported on concrete piles 12 inches square, reinforced with four  $\frac{3}{4}$ -inch square steel rods. The piles were made in forms on a platform outside the trench, and when thoroughly hardened were driven with an ordinary drop-hammer pile driver. Where the pile foundation was placed, the sewer was further strengthened by Ransome twisted steel bars,  $\frac{3}{4}$  of an inch square, laid longitudinally in the arch, sidewalls and invert of the sewer, about 18 inches centre to centre. Three twisted steel rods  $\frac{3}{4}$  of an inch square were placed over each pile bent.

No large amount of water was found in the excavation. It was handled from a well in Columbia Street, near the lower end of the section, by a 4-inch centrifugal pump, electrically driven. For a length of about 830 feet in Columbia Street an 8-inch local sewer, with branches every 25 feet, was laid on the side of the Metropolitan Sewer to provide for the sewage of that side of Columbia Street, cut off from the existing local sewer by the Metropolitan Sewer. From Kenwood Street to near Columbia Place and southerly on Russell Street from Columbia Street about 330 feet the street grades were raised a maximum of about 3 feet. The surplus earth from the excavation was used in filling these streets, under an agreement with the town of Brookline.

The excavation of this section was completed about the middle of November. The sewer for this section is 5 feet 9 inches wide by 6 feet high, of horseshoe section. It is built of Portland concrete, with the wall about 12 inches in thickness. The masonry was completed and the trench backfilled about the first of December. For a length of about 120 feet at the end of the section the excavation was in slate rock at an average depth of 17 feet below the surface.

*Section 85, Brighton.*

*Division Engineer in Charge.* — FRANK I. CAPEN.

*Superintendent of Construction by Day Labor.* — CHAS. A. HASKIN (Sta. 0 to 11 + 42).

*Contractors.* — GEO. M. BRYNE COMPANY, Contract No. 63 (Sta. 11 + 42 to 24 + 00). D. F. O'CONNELL Co., Contract No. 64 (Sta. 24 + 00 to 47 + 00).

HUGH NAWN CONTRACTING COMPANY, Contract No. 65 (Sta. 47 + 00 to 63 + 50).

This section extends from near Allston Street, along Commonwealth Avenue, Warren, Cambridge and Washington streets, to near Lake Street, — a distance of 6,350 feet. The lower portion of this section was constructed by the Board by day labor. Three contracts have been made for the construction of the remainder of the section.

Work was begun by the Board January 5, 1907, at a shaft about 12 feet square, in Commonwealth Avenue, near Allston Street. The excavation of this shaft was about 40 feet in depth, partly in sand, gravel and clay and partly in rock, and was completed February 22. A heading was started from this shaft in a westerly direction towards Warren Street February 23, and extended to a point 548 feet beyond the shaft. This heading was completed August 14.

A heading was started in an easterly direction towards Allston Street February 23, 1907, and extended to a point 601 feet beyond the shaft. This heading was completed August 7.

The excavation in the tunnel headings was largely in rock. For a distance of about 200 feet near the shaft disintegrated slate was encountered. The remainder of the rock excavation was in sandstone. For a length of about 300 feet, at Allston Street, the excavation was wholly in clay. A small amount of water was found and lifted by a small piston pump in the shaft. The excavated material was lifted in buckets at the shaft and conveyed to a rock crusher where the more suitable rock was crushed for concrete purposes. The tunnel headings were about 9 feet high by 9 feet in width, involving about 3 cubic yards of rock excavation per linear foot. A portion of the arch of the east heading farthest from the shaft required timbering, to retain loose, disintegrated rock.

The completed sewer is 5 feet 9 inches wide and 6 feet in height. The masonry walls of the sewer are of concrete, and the tunnel headings are of such dimensions as to yield not less than 12 inches of concrete at any point. The placing of this concrete in the east head-

ing began August 10, 1907, and was completed November 16. The concrete in the west heading was placed between August 15 and October 23. A manhole was constructed in the shaft and the shaft was completely backfilled about December 1.

A contract for a portion of this section in Warren Street was made with the George M. Bryne Company, dated November 27, 1907, for a length of 1,252 feet. At the date of this report the contractor's operations have been confined to erecting plant and necessary building for his machinery.

A contract for a portion of this section in Warren, Cambridge and Washington streets was made with the D. F. O'Connell Company, dated November 25, 1907, for a length of 2,300 feet. A shaft about 12 feet square for tunnel headings was started December 11, on Cambridge Street at Elko Street. At the date of this report this shaft has been excavated to a depth of about 38 feet.

The contract for the portion of this section in Washington Street was made with the Hugh Nawn Contracting Company, dated November 25, 1907, for a length of 1,650 feet. A shaft about 12 feet square for tunnel headings was started December 2, on Washington Street, 200 feet west of Foster Street. At the date of this report the shaft has reached a depth of about 42 feet.

The sewer involved in these three contracts is to be of horseshoe cross-section, 6 feet high and 5 feet 9 inches wide. The masonry walls of the sewer will be of Portland concrete not less than 12 inches in thickness. At the date of this report no masonry has been placed under any of these contracts.

#### ADDITIONAL PUMPING PLANT AT QUINCY STATION.

The two new horizontal tubular boilers and the 10,000,000-gallon Lawrence centrifugal pump and engine described in last year's report in course of installation were completed March 1, 1907. Capacity and efficiency tests indicate that the plant fully satisfies the guarantees of the builders.

This addition to the pumping plant of this station has been used during periods of flood and has given very satisfactory results.

## MAINTENANCE.

## SCOPE OF WORK AND FORCE EMPLOYED.

The maintenance of the Metropolitan Sewerage System includes the operation of seven stations and 98.8 miles of Metropolitan sewers, receiving the discharge from 1,104.25 miles of town and city sewers at 326 points, together with the care and study of inverted siphons under streams and in the harbor.

The permanent maintenance force of 140 men includes 83 engineers and other employés at the pumping stations, and 57 men employed on actual sewer maintenance and care of pumping station grounds. In the three following tables the use of the completed systems and other data are shown: —

## NORTH METROPOLITAN SYSTEM.

*Table showing Cities and Towns delivering Sewage in this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.*

[Populations estimated as of December 31, 1907.]

CITIES AND TOWNS.	Miles of Local Sewer connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection. <sup>1</sup>	Estimated Population now contributing Sewage.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
Boston (Deer Island), <sup>1</sup>	0.70	Separate,	.	—	1,130 <sup>2</sup>	Square Miles.	Square Miles.	Per Cent.	Per Cent.
Wintrop,	27.20	Separate,	.	3.9	7,540	1.23	1.61	98.5	76.4
Boston (East Boston),	28.25	Separate and combined,	1,433	12.4	50,940	1.03	2.18	94.3	47.3
Chelsea,	28.80 <sup>3</sup>	Separate and combined,	4,108	7.0	34,650	1.08	2.24	89.0	48.2
Everett,	42.19	Separate and combined,	4,032	6.2	25,000	1.87	3.34	78.5	56.0
Malden,	50.46	Separate,	4,800	5.6	26,880	2.63	5.07	66.9	51.9
Melrose,	33.43	Separate,	2,524	4.4	11,105	1.68	3.73	74.1	45.0
Boston (Charlestown),	21.48	Separate and combined,	5,173	7.7	39,830	0.67	1.27	99.4	62.8
Cambridge,	135.33	Separate and combined,	14,820	6.7	99,295	4.94	6.11	98.6	80.9
Somerville,	90.92 <sup>5</sup>	Separate and combined,	13,549	5.3	71,810	3.28	3.66	98.0	82.8
Medford,	59.11	Separate,	3,510	5.6	19,655	2.68	8.35	93.6	32.1
Winchester,	92.17	Separate,	1,630	5.4	8,560	1.69	3.35	62.8	18.3
Woburn,	13.24 <sup>6</sup>	Separate,	989	5.4	5,230	0.92	12.71	36.1	7.2
Stonham,	11.39	Separate,	632	4.4	2,780	0.61	5.30	42.3	11.1
Arlington,	20.39	Separate,	1,059	6.1	6,400	1.66	5.20	62.5	31.9
Belmont,	11.63	Separate,	376	5.9	2,607	0.97	4.66	52.9	20.8
Wakfield,	11.20	Separate,	430	5.6	2,440	0.42	7.65	22.5	5.5
Lexington, <sup>8</sup>	—	Separate,	1,891	—	9,080	1.58	5.11	—	—
Revere, <sup>7</sup>	26.35	Separate,	—	4.8	14,010	1.58	5.86	64.1	27.0
Totals,	624.74	—	65,786	6.4	422,065	28.34	90.50	81.6	30.1

<sup>1</sup> Estimated from assessors' statement of the number of houses in each city or town, and the population from census of 1905 extended to May 1, 1907.

<sup>2</sup> Estimated by Superintendent Jas. H. Cronin of the Institution on Deer Island.

<sup>3</sup> The districts connecting at Cypress Street, Revere Beach Parkway, Springvale Avenue, Wiltoughby, Hellingham, Highland, Hawthorn and Spruce streets are now contributing sewage.

<sup>4</sup> Estimated.

<sup>5</sup> Revised in accordance with recent report of the City Engineer.

<sup>6</sup> Exclusive of Mystic River valley sewer and tanneries.

<sup>7</sup> Including 2 connections with McLean Hospital, having an estimated population of 500.

<sup>8</sup> Lexington not connected.



## SOUTH METROPOLITAN SYSTEM.

*Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.*

[Populations estimated as of December 31, 1907.]

CITIES AND TOWNS.	Miles of Local Sewer connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection. <sup>1</sup>	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
Boston (Back Bay),	22.36	Separate and combined,	1,549	18.0	27,920	28,050	1.20	1.61	99.5	74.5
Boston (Brighton),	53.79	Separate and combined,	2,724	6.1	16,615	24,130	3.16	3.74	68.9	84.5
Brookline, . . .	57.89	Separate and combined,	3,256	7.5	24,420	25,280	3.25	6.81	96.6	47.7
Newton, . . .	103.35	Separate, . . .	5,315	5.9	31,360	38,660	6.90	16.88	81.1	40.9
Watertown, . . .	33.39	Separate, . . .	1,690	5.3	8,960	12,090	1.86	4.04	74.1	46.0
Waltham, . . .	42.38	Separate, . . .	3,287	7.8 <sup>2</sup>	25,600	27,720	2.19	13.63	93.4	16.1
Boston (Dorchester),	32.38	Separate and combined,	2,086	6.7	13,980	46,600	1.55	4.89	39.0	31.7
Milton, . . .	7.53	Separate and combined,	211	5.2	1,965	7,440	0.39	12.59	14.7	3.1
Hyde Park, . . .	22.97	Separate, . . .	1,130	7.9 <sup>2</sup>	8,925	15,080	1.16	4.57	59.2	25.4
Dedham, . . .	14.30	Separate, . . .	392	5.0	1,960	7,880 <sup>3</sup>	0.72	9.40	24.9	7.7
Boston (Roxbury),	—	—	—	—	—	33,670	—	1.23	—	—
Boston (West Roxbury),	40.22	Separate, . . .	2,067	6.75	14,830 <sup>4</sup>	28,600	1.96	8.92	51.9	22.0
Quincy, . . .	48.35	Separate, . . .	2,312	5.4	12,485	29,890	2.42	12.56	41.8	19.3
Totals, . . .	479.51	—	26,019	7.2	188,150	325,090	26.76	100.87	57.9	26.5

<sup>1</sup> Estimated from assessors' statement of the number of houses in each city or town, and the population from census of 1905 extended to May 1, 1907.

<sup>2</sup> Estimated by City Engineer.

<sup>3</sup> Part of town not included in Metropolitan Sewerage District.

<sup>4</sup> Including connection with Institution at Austin Farm having an estimated population of 880.

## WHOLE METROPOLITAN SYSTEM.

*Table showing Areas delivering Sewage to the Entire System, inclusive of Added High-level Area ; Approximate Miles of Sewer connected ; Estimated Populations and Areas now contributing ; Total Areas ultimately to contribute, and Present Populations on Such Areas ; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.*

[Populations estimated as of December 31, 1907.]

SYSTEM.	Miles of Local Sewer connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House Connection.	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
North Metropolitan,	624.74	Separate and combined,	65,786	6.4	422,065	498,640	Square Miles. 28.34	Square Miles. 90.50	Per Cent. 84.6	Per Cent. 30.1
South Metropolitan,	479.51	Separate and combined,	26,019	7.2	188,150	325,060	26.76	100.87	57.9	26.5
Totals, . . .	1,104.25	- - -	91,805	6.6	610,215	823,700	55.10	191.37	74.1	28.8

## CAPACITY AND RESULTS.

The following tables summarize the pumping records for the year for the Metropolitan Sewerage stations:—

## NORTH METROPOLITAN SYSTEM.

*Deer Island Pumping Station.*

At this station are three submerged centrifugal pumps, with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of pumps: 45,000,000 gallons each, with 19-foot lift.

Average duty for the year: 56,500,000 foot-pounds.

Average quantity raised each day: 64,300,000 gallons.

Force employed: 4 engineers, 4 firemen, 3 oilers, 3 screenmen and 1 relief screenman.

Coal used: first-quality Cumberland, costing from \$3.95 to \$4.98 per ton.

*Table of Approximate Quantities, Lifts and Duties at the Deer Island Pumping Station of the North Metropolitan System.*

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
<b>1907.</b>						
January, . . .	2,275,100,000	73,400,000	60,800,000	114,900,000	10.91	59,500,000
February, . . .	1,909,100,000	68,200,000	57,000,000	83,100,000	10.77	59,700,000
March, . . .	2,163,100,000	69,800,000	57,300,000	86,500,000	10.96	55,200,000
April, . . .	2,328,400,000	77,600,000	59,500,000	117,700,000	11.41	61,200,000
May, . . .	1,896,500,000	61,200,000	54,600,000	88,200,000	10.67	57,800,000
June, . . .	1,641,600,000	54,700,000	42,600,000	86,500,000	10.55	53,200,000
July, . . .	1,482,000,000	47,800,000	42,600,000	57,400,000	10.22	51,400,000
August, . . .	1,377,800,000	44,400,000	39,600,000	48,800,000	10.02	52,700,000
September, . . .	1,663,500,000	55,500,000	38,300,000	127,400,000	10.44	56,000,000
October, . . .	1,881,800,000	60,700,000	47,500,000	89,000,000	10.61	56,200,000
November, . . .	2,279,100,000	76,000,000	51,600,000	146,100,000	11.19	55,900,000
December, . . .	2,536,700,000	81,800,000	66,700,000	108,500,000	11.67	59,300,000
Total, . . .	23,434,700,000	—	—	—	—	—
Average, . . .	—	64,300,000	51,500,000	96,200,000	10.79	56,500,000

*East Boston Pumping Station.*

At this station are three submerged centrifugal pumps, with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of pumps: 45,000,000 gallons each, with 19-foot lift.

Average duty for the year: 54,800,000 foot-pounds.

Average quantity raised each day: 62,300,000 gallons.

Force employed: 4 engineers, 4 firemen, 3 oilers, 3 screenmen, 1 relief screenman and 3 helpers.

Coal used: first-quality Cumberland, costing from \$3.95 to \$4.98 per ton.

*Table of Approximate Quantities, Lifts and Duties at the East Boston Pumping Station of the North Metropolitan System.*

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
<b>1907.</b>						
January, . . . .	2,213,100,000	71,400,000	58,800,000	112,900,000	17.07	56,000,000
February, . . . .	1,853,100,000	66,200,000	55,000,000	81,100,000	16.94	58,800,000
March, . . . .	2,101,100,000	67,800,000	55,300,000	84,500,000	16.98	62,400,000
April, . . . .	2,268,400,000	75,600,000	57,500,000	115,700,000	17.23	63,300,000
May, . . . .	1,834,500,000	59,200,000	52,600,000	86,200,000	16.66	52,200,000
June, . . . .	1,581,600,000	52,700,000	40,600,000	84,500,000	16.43	52,100,000
July, . . . .	1,420,000,000	45,800,000	40,600,000	55,400,000	16.14	54,700,000
August, . . . .	1,315,800,000	42,400,000	37,600,000	46,800,000	16.10	51,800,000
September, . . . .	1,603,500,000	53,500,000	36,300,000	125,400,000	16.42	50,300,000
October, . . . .	1,819,800,000	58,700,000	45,500,000	87,000,000	16.61	52,900,000
November, . . . .	2,219,100,000	74,000,000	49,600,000	144,100,000	17.03	50,500,000
December, . . . .	2,474,700,000	79,800,000	64,700,000	106,500,000	17.32	52,900,000
Total, . . . .	22,704,700,000	-	-	-	-	-
Average, . . . .	-	62,300,000	49,500,000	94,200,000	16.74	54,800,000

## CHARLESTOWN PUMPING STATION.

At this station are three submerged centrifugal pumps, two of them having impellers or wheels 7.5 feet in diameter, the other 8.25 feet in diameter. They are driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of pumps: two, 22,000,000 gallons each, with 11-foot lift; one, 60,000,000 gallons, with 8-foot lift.

Average duty for the year: 56,700,000 foot-pounds.

Average quantity raised each day: 32,600,000 gallons.

Force employed: 4 engineers, 4 firemen, 3 oilers, 3 screenmen and 1 relief screenman.

Coal used: first-quality Cumberland, costing from \$3.95 to \$4.98 per ton.

*Table of Approximate Quantities, Lifts and Duties at the Charlestown Pumping Station of the North Metropolitan System.*

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
<b>1907.</b>						
January, . . . .	1,096,600,000	35,400,000	30,200,000	50,500,000	8.50	63,100,000
February, . . . .	944,900,000	33,700,000	28,800,000	43,000,000	8.34	58,400,000
March, . . . .	1,050,700,000	33,900,000	27,900,000	45,500,000	8.38	56,200,000
April, . . . .	1,124,300,000	37,500,000	30,000,000	55,100,000	8.55	61,800,000
May, . . . .	924,800,000	29,800,000	25,500,000	44,700,000	8.13	56,300,000
June, . . . .	851,600,000	28,400,000	23,000,000	43,300,000	8.00	56,500,000
July, . . . .	888,400,000	28,700,000	23,600,000	36,000,000	8.02	55,300,000
August, . . . .	910,300,000	29,400,000	24,200,000	36,200,000	8.64	51,600,000
September, . . . .	992,900,000	33,100,000	26,600,000	53,900,000	8.25	56,900,000
October, . . . .	922,000,000	29,700,000	24,600,000	42,100,000	8.07	51,900,000
November, . . . .	1,075,100,000	35,800,000	27,900,000	70,500,000	8.47	57,800,000
December, . . . .	1,101,200,000	35,500,000	27,800,000	46,900,000	8.31	54,100,000
Total, . . . .	11,882,800,000	-	-	-	-	-
Average, . . . .	-	32,600,000	26,700,000	47,300,000	8.31	56,700,000



*Alewife Brook Pumping Station.*

The plant at this station consists of the original installation of small commercial pumps and engines, *i.e.*, two 9-inch Andrews vertical centrifugal pumps, with direct-connected compound marine engines, together with the recent additions. The latter consists of a specially designed engine of the vertical cross-compound type, having between the cylinders a centrifugal pump rotating on a horizontal axis.

Contract capacity of the two original pumps: 4,500,000 gallons each, with 13-foot lift.

Contract capacity of new pump: 13,000,000 gallons, with 13-foot lift.

Average duty for the year: 19,300,000 foot-pounds.

Average quantity raised each day: 4,123,000 gallons.

Force employed: 3 engineers, 1 relief engineer, 2 screenmen, and 1 relief screenman.

Coal used: first-quality Cumberland, costing from \$4.32 to \$4.90 per ton.

*Table of Approximate Quantities, Lifts and Duties at the Alewife Brook Pumping Station of the North Metropolitan System.*

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
<b>1907.</b>						
January, . . . .	142,672,000	4,602,000	3,862,000	6,518,000	12.66	20,800,000
February, . . . .	112,797,000	4,029,000	3,574,000	5,170,000	12.92	18,100,000
March, . . . .	136,980,000	4,419,000	3,028,000	6,076,000	12.79	20,000,000
April, . . . .	155,482,000	5,183,000	3,910,000	7,630,000	12.77	23,500,000
May, . . . .	119,701,000	3,861,000	3,279,000	6,206,000	12.77	20,000,000
June, . . . .	105,489,000	3,516,000	3,028,000	5,105,000	12.97	17,700,000
July, . . . .	93,033,000	3,001,000	2,598,000	3,766,000	13.10	15,300,000
August, . . . .	76,284,000	2,460,000	2,120,000	3,079,000	13.13	13,600,000
September, . . . .	95,640,000	3,188,000	2,204,000	7,344,000	13.02	15,500,000
October, . . . .	120,301,000	3,881,000	3,279,000	4,677,000	12.92	18,700,000
November, . . . .	161,561,000	5,385,000	3,279,000	9,114,000	12.87	23,600,000
December, . . . .	184,493,000	5,951,000	4,799,000	7,521,000	12.83	24,200,000
Total, . . . .	1,504,433,000	-	-	-	-	-
Average, . . . .	-	4,123,000	3,247,000	6,018,000	12.90	19,300,000

## SOUTH METROPOLITAN SYSTEM.

*Ward Street Pumping Station.*

At this station are two vertical, triple-expansion pumping engines, of the Allis-Chalmers type, operating reciprocating pumps, the plungers of which are 48 inches in diameter with a 60-inch stroke.

Contract capacity of pumps: 50,000,000 gallons each, with 45-foot lift.

Average duty for the year: 82,200,000 foot-pounds.

Average quantity raised each day: 23,500,000 gallons.

Force employed: 4 engineers, 4 firemen, 3 oilers, 4 assistant engineers, 1 machinist and 1 laborer.

Coal used: first quality Cumberland, costing from \$4.17 to \$5.00 per ton.

*Table of Approximate Quantities, Lifts and Duties at the Ward Street Pumping Station of the South Metropolitan System.*

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
<b>1907.</b>						
January, . . . .	796,700,000	25,700,000	23,000,000	37,800,000	41.52	88,500,000
February, . . . .	575,000,000	20,500,000	18,000,000	26,600,000	41.25	74,200,000
March, . . . . .	815,000,000	26,300,000	17,500,000	33,400,000	42.33	85,300,000
April, . . . . .	867,000,000	28,900,000	19,400,000	37,200,000	42.21	87,000,000
May, . . . . .	719,000,000	23,200,000	20,000,000	31,200,000	41.50	76,500,000
June, . . . . .	600,300,000	20,000,000	17,200,000	28,100,000	41.40	75,500,000
July, . . . . .	550,200,000	17,700,000	14,000,000	23,300,000	41.10	70,500,000
August, . . . . .	469,600,000	15,100,000	13,100,000	28,500,000	40.53	72,100,000
September, . . . .	595,500,000	19,800,000	13,800,000	45,800,000	41.50	86,500,000
October, . . . . .	682,200,000	22,000,000	17,000,000	38,800,000	42.03	87,000,000
November, . . . .	912,000,000	30,400,000	21,300,000	66,100,000	41.82	91,400,000
December, . . . .	1,007,500,000	32,500,000	25,900,000	46,100,000	41.70	92,000,000
Total, . . . . .	8,590,000,000	-	-	-	-	-
Average, . . . .	-	23,500,000	18,000,000	36,900,000	41.57	82,200,000

Records from plunger displacement.

Average slip for the year about 9.9 per cent.

*Quincy Pumping Station.*

At this station are two compound condensing Deane pumping engines and one Lawrence centrifugal pump driven by a Sturtevant compound condensing engine.

Contract capacity of pumps: 3,000,000 Deane; 5,000,000 Deane; 10,000,000 Lawrence centrifugal.

Average duty for the year: 31,800,000 foot-pounds.

Average quantity raised each day: 3,616,000 gallons.

Force employed: 3 engineers, 1 relief engineer, 2 screenmen and 1 relief screenman.

Coal used: first-quality Cumberland, costing from \$4.75 to \$5.25 per ton.

*Table of Approximate Quantities, Lifts and Duties at the Quincy Pumping Station of the South Metropolitan System.*

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
<b>1907.</b>						
January, . . . . .	123,764,000	3,992,000	3,583,000	4,505,000	20.88	36,000,000
February, . . . . .	101,133,000	3,611,000	3,253,000	3,920,000	21.50	33,000,000
March, . . . . .	131,635,000	4,246,000	3,360,000	5,650,000	21.43	33,500,000
April, . . . . .	128,690,000	4,289,000	3,770,000	4,980,000	21.04	33,000,000
May, . . . . .	114,159,000	3,683,000	3,340,000	3,940,000	20.99	33,800,000
June, . . . . .	105,640,000	3,521,000	3,100,000	4,520,000	20.98	31,200,000
July, . . . . .	92,257,000	2,974,000	2,710,000	3,340,000	20.99	28,800,000
August, . . . . .	80,346,000	2,592,000	2,300,000	2,960,000	21.00	30,800,000
September, . . . . .	80,662,000	2,688,000	2,319,000	3,520,000	20.94	31,300,000
October, . . . . .	96,414,000	3,110,000	2,800,000	3,380,000	20.88	32,600,000
November, . . . . .	114,887,000	3,830,000	2,950,000	5,720,000	20.87	29,200,000
December, . . . . .	150,257,000	4,847,000	3,940,000	5,835,000	21.03	28,600,000
Total, . . . . .	1,319,844,000	-	-	-	-	-
Average, . . . . .	-	3,615,000	3,124,000	4,356,000	21.04	31,800,000

*Nut Island Screen House.*

The plant at the house includes two sets of screens in duplicate, actuated by small reversing engines of the Fitchburg type. Two vertical Deane boilers, 80 horse-power each, operate the engines, provide heat for the house and burn materials intercepted at the screens.

Average quantity of sewage passing screens daily, 40,600,000 gallons.

Total materials intercepted at screens during the past year, 1,056 cubic yards.

Materials intercepted per million gallons of sewage discharge, 1.92 cubic feet.

Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenman.

Coal used: 294 tons first-quality Cumberland, costing from \$3.95 to \$4.98 per ton.

## COST OF PUMPING.

In the following tables the total cost of pumping and the rate per million foot-gallons at each of six pumping stations are shown in detail: —

*Average Cost per Million Foot-gallons for Pumping at the Deer Island Station.*

Volume (23,434.7 Million Gallons)  $\times$  Lift (10.79 Feet) = 252,860 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor, . . . . .	\$41,147 03	\$0.04409
Coal, . . . . .	9,242 52	.03655
Oil, . . . . .	248 01	.00098
Waste, . . . . .	89 69	.00036
Water, . . . . .	1,067 40	.00422
Packing, . . . . .	219 92	.00087
Miscellaneous supplies and renewals, . . . . .	2,458 50	.00972
Totals, . . . . .	\$24,473 07	\$0.00679
Labor at screens, . . . . .	-	.01079

*Average Cost per Million Foot-gallons for Pumping at the East Boston Station.*

Volume (22,704.7 Million Gallons)  $\times$  Lift (16.74 Feet) = 380,076 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor, . . . . .	\$14,187 31	\$0.03733
Coal, . . . . .	12,432 35	.03271
Oil, . . . . .	390 29	.00103
Waste, . . . . .	86 23	.00023
Water, . . . . .	1,396 80	.00367
Packing, . . . . .	44 37	.00012
Miscellaneous supplies and renewals, . . . . .	2,146 61	.00565
Totals, . . . . .	\$30,683 96	\$0.08074
Labor at screens, . . . . .	-	.00718

*Average Cost per Million Foot-gallons for Pumping at the Charlestown Station.*Volume (11,882.8 Million Gallons)  $\times$  Lift (8.31 Feet) = 98,746 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor, . . . . .	\$11,176 51	\$0.11319
Coal, . . . . .	3,730 66	.03778
Oil, . . . . .	202 00	.00204
Waste, . . . . .	106 12	.00107
Water, . . . . .	411 60	.00417
Packing, . . . . .	54 01	.00055
Miscellaneous supplies and renewals, . . . . .	956 93	.00969
Totals, . . . . .	\$16,637 83	\$0.16849
Labor at screens, . . . . .	-	.02896

*Average Cost per Million Foot-gallons for Pumping at the Alewife Brook Station.*Volume (1,504.4 Million Gallons)  $\times$  Lift (12.90 Feet) = 19,406 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor, . . . . .	\$4,378 65	\$0.22563
Coal, . . . . .	1,782 41	.09185
Oil, . . . . .	107 07	.00552
Waste, . . . . .	45 43	.00234
Water, . . . . .	170 16	.00877
Packing, . . . . .	15 43	.00079
Miscellaneous supplies and renewals, . . . . .	177 05	.00912
Totals, . . . . .	\$6,676 20	\$0.34402
Labor at screens, . . . . .	-	.09379

*Average Cost per Million Foot-gallons for Pumping at the Ward Street Station.*Volume (8,590 Million Gallons)  $\times$  Lift (41.57 Feet) = 357,090 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor, . . . . .	\$14,024 33	\$0.03928
Coal, . . . . .	8,451 03	.02367
Oil, . . . . .	206 32	.00058
Waste, . . . . .	67 83	.00019
Water, . . . . .	1,312 80	.00368
Packing, . . . . .	830 71	.00232
Miscellaneous supplies and renewals, . . . . .	1,446 23	.00405
Totals, . . . . .	\$26,339 90	\$0.07377
Labor at screens, . . . . .	-	.01070



*Average Cost per Million Foot-gallons for Pumping at the Quincy Station.*Volume (1,319.8 Million Gallons)  $\times$  Lift (21.04 Feet) = 27,768 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor, . . . . .	\$4,833 58	\$0.17407
Coal, . . . . .	1,701 25	.06126
Oil, . . . . .	25 15	.00091
Waste, . . . . .	14 16	.00051
Water, . . . . .	191 52	.00690
Packing, . . . . .	42 39	.00153
Miscellaneous supplies and renewals, . . . . .	243 26	.00876
Totals, . . . . .	\$7,051 31	\$0.25394
Labor at screens, . . . . .	-	.05618

Coal for use at the several stations has been purchased as follows:—

	GROSS TONS, BITUMINOUS COAL.							Price per Gross Ton.
	Deer Island Pumping Station.	East Boston Pumping Station.	Charles- town Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screen House.	
Metropolitan Coal Com- pany.	1,635	1,808.53	586	-	-	-	200	\$3.95
Metropolitan Coal Com- pany.	-	-	-	-	1,555.15	-	-	4.17
Locke Coal Company, .	-	-	-	298.127	-	-	-	4.32
George E. Frost & Co.,	-	-	-	-	-	287.34	-	4.75
Locke Coal Company, .	-	-	-	136.490	-	-	-	4.90
Metropolitan Coal Com- pany.	481	910.00	215	-	-	-	-	4.98
Metropolitan Coal Com- pany.	-	-	-	-	457.48	-	-	5.00
George E. Frost & Co.,	-	-	-	-	-	90.83	-	5.25
Total gross tons, .	2,116	2,718.53	801	434.617	2,012.63	378.17	200	-
Average price per gross ton.	\$4.18	\$4.29	\$4.23	\$4.50	\$4.35	\$4.87	\$3.95	-

## SOUTH METROPOLITAN OUTFALLS.

The 60-inch outlet pipes in the harbor have been in operation three years at the date of this report. Studies of the hydraulic condition of these pipes indicate they are in normal condition and free from deposit. During the past year the average flow through them

has been 40,600,000 gallons of sewage per day, with a maximum rate of 137,000,000 gallons at a time of heavy rain about December 1, 1907.

#### MATERIAL INTERCEPTED AT THE SCREENS.

The material intercepted at the screens at the North Metropolitan sewerage stations, consisting of rags, paper and other floating matters, has during the year amounted to 2,422.2 cubic yards. This is equivalent to 2.8 cubic feet for each million gallons of sewage pumped at Deer Island.

The material intercepted at the screens at the South Metropolitan sewerage stations has amounted to 2,735.6 cubic yards, equal to 5.0 cubic feet per million gallons of sewage delivered at the outfall works at Nut Island.

Studies of sewage flows in the Metropolitan sewers, siphons and outfall pipes indicate that they are satisfactorily free from deposit and in normal condition.

Respectfully submitted,

WM. M. BROWN,

*Chief Engineer of Sewerage Works.*

Boston, January 1, 1908.

---

---

# APPENDIX.

---

---

## APPENDIX No. 1.

## CONTRACTS MADE AND PENDING DURING

[NOTE.—The details of contracts made before

	1. Number of Con- tract.	2.  WORK.	3.  Number of Bids.	AMOUNT OF BID.		6.  Contractor.
				4. Next to Low- est.	5. Lowest.	
1	288	Pumping engine for the Arlington station.	7	\$7,900 00	\$7,830 00	Allis-Chalmers Co., Milwaukee, Wis.
2	294 1	Arlington pumping sta- tion.	5	29,093 00	28,328 00 2	C. A. Dodge & Co., Boston.
3	295 1	Sterling filter beds, Ster- ling, Mass.	5	10,230 50	9,803 50 2	A. McKenzie & Co., Leominster, Mass.
4	297 1	Horizontal return tubular boilers, Arlington and Chestnut Hill stations.	3	6,694 00 2	6,600 00	Hodge Boiler Works, Boston.
5	298	Pumping engine for the Arlington station.	2	12,700 00	5,240 00 2	Blake & Knowles Steam Pump Works, Boston.
6	9-M 1	Repairing boiler at Chest- nut Hill high-service pumping station.	2	2,766 00	1,791 00 2	Hodge Boiler Works, Boston.
7	10-M	Placing riprap at North Dike, Clinton, Mass.	2	19,250 00	14,000 00 2	Hugh Nawn Contract- ing Co., Boston.
8	Special Order. 1	Furnishing and erecting electric apparatus in gate-house at Wachu- sett Dam.	3	888 23	864 00 2	Frank Ridlon Com- pany, Boston.
9	Special Order. 1	Hercules water wheel at Wachusett Dam.	2	1,050 00	900 00 2	Holyoke Machine Co., Holyoke, Mass.
10	Special Order. 1	Cut stone for retaining wall at the Arlington pumping station.	4	637 00	598 00 2	John Harrington, East Cambridge, Mass.

<sup>1</sup> Contract completed.<sup>2</sup> Contract based upon this bid.

## APPENDIX NO. 1.

## THE YEAR 1907 — WATER WORKS.

1907 have been given in previous reports.]

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1907.	10. Value of Work done Decem- ber 31, 1907.	
Oct. 28, '05,	-	-	\$9,900 00	1
Aug. 23, '06,	July 19, '07,	-	29,498 21	2
Sept. 1, '06,	May 25, '07,	-	11,893 75	3
Jan. 30, '07,	Oct. 7, '07,	For whole work, \$6,694, . . . . .	6,694 00	4
Apr. 3, '07,	-	For whole work, \$5,240, . . . . .	4,000 00	5
Nov. 28, '06,	Apr. 11, '07,	-	1,791 00	6
Sept. 6, '07,	-	Riprap in place, \$2.00 per cubic yard, . . . .	12,800 00	7
June 7, '06,	Apr. 3, '07,	-	864 00	8
Aug. 27, '06,	June 15, '07,	-	900 00	9
Nov. 16, '06,	Mar. 30, '07,	-	598 00	10
			\$79,438 96	



CONTRACTS MADE AND PENDING DURING THE YEAR 1907 — WATER WORKS —  
*Concluded.*

**Summary of Contracts.<sup>1</sup>**

	Value of Work done Decem- ber 31, 1907.
Wachusett Reservoir, 1 contract, . . . . .	\$11,893 75
Distribution Department, 4 contracts, . . . . .	50,092 21
Total of 5 contracts made and pending during the year 1907, . . . . .	\$61,985 96
288 contracts completed from 1896 to 1906, inclusive, . . . . .	15,715,263 93
	\$15,777,249 89
Deduct for work done on 11 Sudbury Reservoir contracts by the city of Boston, .	512,000 00
Total of 304 contracts, . . . . .	\$15,265,249 89

<sup>1</sup> In this summary, contracts charged to maintenance are excluded.

## APPENDIX NO. 2.

TABLE NO. 1. -- Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works, in 1907.

Place.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
Wachusett Watershed.													
Princeton, . . . . .	2.64	1.86	1.51	2.07	2.81	3.54 <sup>1</sup>	3.03 <sup>1</sup>	1.00	9.45	5.48	5.52	4.02	42.83
Jefferson, . . . . .	2.95	2.37	1.87	3.04	3.14	3.49	3.09	1.37	9.70	6.51	6.02	4.82	48.37
Sterling, . . . . .	2.71	2.79	1.85	2.23	2.78	3.49	3.53	1.05	8.74	5.62	5.43	4.01	44.23
Boyiston, . . . . .	3.06	2.27	2.05	3.26	3.11	3.64	2.48	1.61	10.10	5.10	5.99	4.76	47.43
Sudbury Dam, . . . . .	3.14	2.17	1.81	3.51	3.60	3.46	1.56	1.09	8.97	4.27	5.53	4.30	43.41
Framlingham, . . . . .	3.41	2.18	1.79	3.05	3.53	3.20	1.71	1.07	8.32	3.83	5.84	4.17	42.10
Ashland Dam, . . . . .	3.16	2.13	1.86	3.39	3.53	2.91	2.03	1.05	8.07	4.07	6.05	4.58	42.83
Cordaville, . . . . .	3.43	2.21	2.19	3.67	3.87	4.56	2.12	1.07	9.68	4.51	7.05	4.82	49.18
Lake Cochituate, . . . . .	3.14	2.18	1.88	3.47	3.62	2.89	1.45	1.27	7.62	3.96	5.63	3.66	40.77
Chestnut Hill Reservoir, . . . . .	3.80	3.31	2.44	3.72	4.06	3.39	1.49	1.79	10.02	3.65	7.91	6.25	51.83
Spot Pond, . . . . .	2.90	2.19	2.43	3.31	3.06	3.71	1.91	1.33	8.88	2.98	6.76	3.88	43.34
Average of all, . . . . .	3.12	2.33	1.97	3.16	3.37	3.48	2.22	1.25	9.05	4.54	6.16	4.48	45.13
Average, Wachusett watershed,	2.84	2.32	1.82	2.65	2.96	3.54	3.03	1.26	9.50	5.68	5.74	4.40	45.74
Average, Sudbury watershed, .	3.28	2.17	1.91	3.41	3.63	3.53	1.86	1.07	8.76	4.17	6.12	4.47	44.38

<sup>1</sup> No record. Average of other three places on the watershed.

TABLE NO. 2. — *Rainfall in Inches at Jefferson, Mass., in 1907.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1, . . . . .	-	0.25 <sup>1</sup>	-	<sup>2</sup>	-	-	-	-	-	-	-	-
2, . . . . .	-	-	0.43	0.33 <sup>1</sup>	-	<sup>2</sup>	-	0.33	<sup>2</sup>	-	<sup>2</sup>	-
3, . . . . .	<sup>2</sup>	-	-	-	-	0.75	-	-	<sup>2</sup>	-	1.85	-
4, . . . . .	0.42	<sup>2</sup>	0.04 <sup>1</sup>	-	0.39	<sup>2</sup>	-	0.40	1.51	0.65	-	0.08 <sup>1</sup>
5, . . . . .	-	1.52 <sup>1</sup>	-	-	-	0.42	-	-	0.66	-	-	-
6, . . . . .	-	-	-	-	0.14	-	0.3 <sup>s</sup>	-	-	-	<sup>2</sup>	-
7, . . . . .	<sup>2</sup>	-	-	-	-	-	-	-	-	0.11	2.14	-
8, . . . . .	0.35	-	0.03 <sup>1</sup>	1.04 <sup>1</sup>	-	-	-	-	0.09	3.07	-	-
9, . . . . .	-	-	-	<sup>2</sup>	0.11	<sup>2</sup>	-	-	-	-	-	-
10, . . . . .	-	0.04 <sup>1</sup>	0.08 <sup>1</sup>	0.82 <sup>1</sup>	-	0.24	-	-	<sup>2</sup>	-	0.44	1.32
11, . . . . .	-	-	-	-	0.36	-	<sup>2</sup>	-	1.02	0.06	-	-
12, . . . . .	0.28 <sup>3</sup>	-	-	-	-	-	1.17	-	-	-	-	-
13, . . . . .	-	-	0.19	-	-	-	-	-	-	-	-	-
14, . . . . .	0.22 <sup>1</sup>	-	0.38	-	-	-	-	-	-	-	-	<sup>2</sup>
15, . . . . .	-	-	-	-	-	-	-	-	-	-	-	1.61 <sup>3</sup>
16, . . . . .	-	-	0.03 <sup>1</sup>	-	0.82	-	-	-	-	-	-	-
17, . . . . .	<sup>2</sup>	-	-	-	-	-	0.54	0.25	-	-	-	-
18, . . . . .	<sup>2</sup>	-	-	-	-	-	-	-	-	-	<sup>2</sup>	-
19, . . . . .	0.40 <sup>3</sup>	0.07 <sup>1</sup>	0.25	-	-	-	-	-	-	-	0.27	-
20, . . . . .	-	0.11 <sup>1</sup>	-	-	0.19	-	0.43	-	-	0.52	-	-
21, . . . . .	-	-	-	-	-	-	-	0.05	0.60	-	-	-
22, . . . . .	0.33 <sup>1</sup>	-	-	-	-	0.31	-	-	<sup>2</sup>	-	-	-
23, . . . . .	-	-	-	<sup>2</sup>	-	-	-	-	3.70	-	-	1.20
24, . . . . .	-	<sup>2</sup>	0.44 <sup>1</sup>	0.70	-	-	0.10	0.11	-	-	<sup>2</sup>	-
25, . . . . .	<sup>2</sup>	0.38 <sup>1</sup>	-	-	-	-	-	-	-	-	1.12 <sup>3</sup>	-
26, . . . . .	0.90 <sup>1</sup>	-	-	-	<sup>2</sup>	0.17	0.42	-	-	-	0.20 <sup>3</sup>	-
27, . . . . .	-	-	-	-	1.06	-	-	0.09	-	<sup>2</sup>	-	-
28, . . . . .	-	-	-	0.15	-	-	-	-	<sup>2</sup>	<sup>2</sup>	-	0.02
29, . . . . .	-	-	-	-	-	<sup>2</sup>	-	-	2.12	2.10	-	-
30, . . . . .	-	-	-	-	0.07	1.60	-	0.14	-	-	-	0.59
31, . . . . .	0.05 <sup>1</sup>	-	-	-	-	-	-	-	-	-	-	-
Total, . . . . .	2.95	2.37	1.87	3.04	3.14	3.49	3.09	1.37	9.70	6.51	6.02	4.82

Total for the year, 48.37 inches.

<sup>1</sup> Snow.<sup>2</sup> Rainfall included in that of following day.<sup>3</sup> Rain and snow.

TABLE No. 3. — *Rainfall in Inches at Framingham, Mass., in 1907.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1, . . . . .	-	0.25 <sup>3</sup>	<sup>2</sup>	<sup>2</sup>	-	-	-	-	-	-	-	0.15 <sup>1</sup>
2, . . . . .	-	0.05	0.40	0.25 <sup>3</sup>	-	<sup>2</sup>	0.02	0.03	<sup>2</sup>	-	<sup>2</sup>	-
3, . . . . .	<sup>2</sup>	-	<sup>2</sup>	-	-	1.49	-	-	<sup>2</sup>	<sup>2</sup>	1.28	<sup>2</sup>
4, . . . . .	0.59	<sup>2</sup>	0.11 <sup>1</sup>	<sup>2</sup>	0.35	-	-	0.31	<sup>2</sup>	0.45	-	0.17 <sup>1</sup>
5, . . . . .	-	1.03 <sup>1</sup>	-	0.04	-	0.22	-	<sup>2</sup>	1.93	0.02	-	-
6, . . . . .	-	-	-	-	<sup>2</sup>	-	0.14	0.02	-	-	<sup>2</sup>	-
7, . . . . .	<sup>2</sup>	-	-	-	0.29	-	-	-	-	-	1.72	-
8, . . . . .	0.42	-	0.06 <sup>1</sup>	<sup>2</sup>	<sup>2</sup>	-	-	-	0.14	1.37	-	-
9, . . . . .	-	-	-	<sup>2</sup>	0.11	<sup>2</sup>	-	-	-	-	<sup>2</sup>	-
10, . . . . .	-	0.05 <sup>3</sup>	0.14 <sup>1</sup>	<sup>2</sup>	<sup>2</sup>	0.26	-	-	-	-	0.45	1.25
11, . . . . .	-	-	-	1.79 <sup>3</sup>	0.90 <sup>3</sup>	-	<sup>2</sup>	-	0.47	0.02	-	-
12, . . . . .	0.24 <sup>3</sup>	-	<sup>2</sup>	-	-	-	0.60	-	-	-	-	-
13, . . . . .	-	-	<sup>2</sup>	0.27 <sup>3</sup>	-	-	-	-	-	-	-	-
14, . . . . .	<sup>2</sup>	-	0.27	-	-	-	-	-	-	-	-	<sup>2</sup>
15, . . . . .	0.29 <sup>3</sup>	-	0.01 <sup>1</sup>	-	-	-	-	-	-	-	-	<sup>2</sup>
16, . . . . .	-	-	-	-	<sup>2</sup>	-	-	-	-	-	-	1.34 <sup>3</sup>
17, . . . . .	0.11 <sup>1</sup>	0.06 <sup>1</sup>	-	-	0.53 <sup>3</sup>	-	0.10	0.15	-	-	-	-
18, . . . . .	-	-	-	-	-	0.03	-	-	-	-	<sup>2</sup>	-
19, . . . . .	0.36	0.11 <sup>3</sup>	0.30 <sup>3</sup>	0.06 <sup>3</sup>	<sup>2</sup>	-	-	-	-	-	0.34	-
20, . . . . .	-	0.31 <sup>1</sup>	-	-	0.37	0.06	0.12	-	-	0.46	-	-
21, . . . . .	-	-	-	-	-	0.05	-	0.02	0.34	-	0.08	-
22, . . . . .	0.23 <sup>1</sup>	-	-	-	-	-	-	-	<sup>2</sup>	-	-	-
23, . . . . .	-	-	-	<sup>2</sup>	-	-	-	-	2.62	-	-	0.70
24, . . . . .	-	0.30 <sup>1</sup>	0.26 <sup>3</sup>	0.57	-	-	<sup>2</sup>	<sup>2</sup>	0.11	-	<sup>2</sup>	-
25, . . . . .	<sup>2</sup>	-	-	-	-	-	0.40	0.14	-	-	1.93	-
26, . . . . .	0.93 <sup>1</sup>	-	-	0.02	<sup>2</sup>	0.03	0.31	-	-	-	0.04 <sup>3</sup>	-
27, . . . . .	-	-	0.10	-	0.96	-	-	0.11	-	<sup>2</sup>	-	-
28, . . . . .	-	0.02 <sup>1</sup>	0.08	<sup>2</sup>	-	-	-	-	<sup>2</sup>	<sup>2</sup>	-	0.01
29, . . . . .	<sup>2</sup>	-	-	0.03	-	<sup>2</sup>	0.02	-	2.71	<sup>2</sup>	-	-
30, . . . . .	0.05 <sup>1</sup>	-	-	0.02	0.02	1.06	-	0.29	-	1.51	-	0.55
31, . . . . .	0.19 <sup>1</sup>	-	0.06 <sup>3</sup>	-	-	-	-	-	-	-	-	-
Total, . . . . .	3.41	2.18	1.79	3.05	3.53	3.20	1.71	1.07	8.32	3.83	5.84	4.17

Total for the year, 42.10 inches.

<sup>1</sup> Snow.<sup>2</sup> Rainfall included in that of the following day.<sup>3</sup> Rain and snow.

TABLE NO. 4.—*Rainfall in Inches at Chestnut Hill Reservoir in 1907.*

DATE.	Amount.	Duration.	DATE	Amount.	Duration.
Jan. 3, . . .	.55	4.00 P.M. to 3.00 P.M.	May 4, . . .	.54	6.25 A.M. to 1.30 P.M.
Jan. 4, . . .	.44 <sup>1</sup>	9.07 P.M. to 1.40 A.M.	May 6, . . .	.32	6.20 A.M. to 11.30 P.M.
Jan. 7, . . .	.33 <sup>1</sup>	9.30 A.M. to 9.00 P.M.	May 9, . . .	.14	5.00 A.M. to 1.30 P.M.
Jan. 12, . . .	.42 <sup>2</sup>	7.45 A.M. to 6.30 P.M.	May 10, . . .	1.22 <sup>2</sup>	11.00 P.M. to 1.30 P.M.
Jan. 14, . . .	.17 <sup>1</sup>	11.30 A.M. to 6.00 P.M.	May 11, . . .	.70	8.15 P.M. to 5.10 A.M.
Jan. 17, . . .	.35	9.30 A.M. to 10.40 P.M.	May 16, . . .	.43	5.25 P.M. to 7.30 A.M.
Jan. 19, . . .	.26 <sup>1</sup>	8.30 A.M. to 8.15 P.M.	May 17, . . .	.67	11.30 A.M. to 11.55 P.M.
Jan. 22, . . .	1.14 <sup>1</sup>	7.05 A.M. to 1.15 P.M.	May 20, . . .	.02	7.00 P.M. to 2.50 A.M.
Jan. 25, . . .	.14 <sup>1</sup>	11.45 P.M. to 10.30 A.M.	May 26, . . .	.02	9.00 P.M. to 9.30 P.M.
Jan. 26, . . .			May 27, . . .		
Jan. 29, . . .			May 30, . . .		
Jan. 30, . . .			May 31, . . .		
Total, . . .	3.80		Total, . . .	4.06	
Feb. 1, . . .	.31 <sup>2</sup>	1.35 A.M. to 1.30 P.M.	June 2, . . .	1.67	8.15 A.M. to 4.30 P.M.
Feb. 2, . . .	.24	1.30 A.M. to 7.45 A.M.	June 3, . . .	.37	9.00 A.M. to 1.40 A.M.
Feb. 2, . . .	.02	11.20 P.M. to 12.40 A.M.	June 6, . . .	.20	10.45 A.M. to 7.10 A.M.
Feb. 3, . . .	1.33 <sup>1</sup>	10.40 P.M. to 2.00 P.M.	June 9, . . .	.02	6.00 A.M. to 6.30 A.M.
Feb. 4, . . .	.06 <sup>1</sup>	4.15 P.M. to 9.30 A.M.	June 20, . . .	.04	7.00 P.M. to 10.45 P.M.
Feb. 5, . . .	.13 <sup>1</sup>	5.25 A.M. to 12.30 P.M.	June 26, . . .	1.09	5.30 P.M. to 9.20 A.M.
Feb. 10, . . .	.03 <sup>1</sup>	5.30 P.M. to 6.00 P.M.	June 29, . . .		
Feb. 11, . . .	.25 <sup>1</sup>	7.30 P.M. to 12.00 M.	June 30, . . .		
Feb. 17, . . .	.08 <sup>1</sup>	3.50 P.M. to 9.00 P.M.	Total, . . .	3.39	
Feb. 18, . . .	.49 <sup>1</sup>	4.45 P.M. to 3.25 A.M.			
Feb. 19, . . .	.31 <sup>1</sup>	5.00 P.M. to 3.45 A.M.	July 3, . . .	.03	1.30 A.M. to 4.35 A.M.
Feb. 20, . . .	.06	6.45 P.M. to 10.00 P.M.	July 9, . . .	.08	12.15 P.M. to 1.00 P.M.
Feb. 21, . . .			July 11, . . .	.50	10.30 A.M. to 11.30 A.M.
Feb. 24, . . .			July 12, . . .	.09	9.00 P.M. to 10.30 P.M.
Feb. 25, . . .			July 17, . . .	.19	9.30 P.M. to 11.50 P.M.
Feb. 28, . . .			July 20, . . .	.27	10.00 P.M. to 3.15 A.M.
Total, . . .	3.31		July 24, . . .	.33	7.05 A.M. to 10.35 A.M.
Mar. 2, . . .	.62 <sup>2</sup>	1.25 A.M. to 6.20 A.M.	July 25, . . .		
Mar. 3, . . .	.13 <sup>1</sup>	8.30 A.M. to 2.30 P.M.	July 26, . . .		
Mar. 8, . . .	.18 <sup>1</sup>	9.30 A.M. to 2.25 A.M.	Total, . . .	1.49	
Mar. 10, . . .	.27	1.00 A.M. to 10.30 A.M.			
Mar. 11, . . .	.10	4.15 A.M. to 1.30 P.M.	Aug. 4, . . .	.40	3.30 A.M. to 12.15 P.M.
Mar. 13, . . .	.04	1.45 A.M. to 2.20 A.M.	Aug. 5, . . .	.11	10.30 P.M. to 1.30 P.M.
Mar. 14, . . .	.36 <sup>2</sup>	2.00 P.M. to 12.15 A.M.	Aug. 6, . . .	.19	4.35 A.M. to 5.50 A.M.
Mar. 19, . . .	.24 <sup>1</sup>	1.00 A.M. to 10.30 P.M.	Aug. 17, . . .	.11	10.30 A.M. to 12.30 P.M.
Mar. 20, . . .	.15	11.50 P.M. to 2.10 A.M.	Aug. 21, . . .	.10	4.15 P.M. to 5.30 P.M.
Mar. 24, . . .	.09	12.50 P.M. to 1.15 P.M.	Aug. 24, . . .	.14	9.15 A.M. to 9.10 A.M.
Mar. 28, . . .	.26	11.50 P.M. to 7.00 A.M.	Aug. 25, . . .	.23	8.30 P.M. to 5.20 A.M.
Mar. 31, . . .			Aug. 27, . . .	.51	1.40 P.M. to 4.25 A.M.
Apr. 1, . . .			Aug. 28, . . .		
Total, . . .	2.44		Aug. 30, . . .		
Apr. 1, . . .	.20 <sup>2</sup>	7.00 A.M. to 2.50 A.M.	Aug. 31, . . .		
Apr. 2, . . .	.10	6.00 A.M. to 10.30 A.M.	Total, . . .	1.79	
Apr. 5, . . .	1.20 <sup>2</sup>	8.30 A.M. to 12.00 M't.			
Apr. 8, . . .	.12 <sup>2</sup>	7.00 A.M. to 4.05 A.M.	Sept. 2, . . .	3.34	8.00 A.M. to 3.15 P.M.
Apr. 10, . . .	.06	11.30 A.M. to 5.15 A.M.	Sept. 5, . . .	.06	10.45 A.M. to 4.30 P.M.
Apr. 11, . . .	.25	6.10 A.M. to 3.30 P.M.	Sept. 8, . . .	.31	3.40 P.M. to 11.40 P.M.
Apr. 13, . . .	.04 <sup>2</sup>	10.50 P.M. to 3.05 A.M.	Sept. 11, . . .	.23	7.15 P.M. to 10.00 P.M.
Apr. 16, . . .	.05	1.05 P.M. to 6.15 P.M.	Sept. 21, . . .	2.35	10.00 P.M. to 12.20 A.M.
Apr. 17, . . .	.60	9.40 P.M. to 10.15 A.M.	Sept. 22, . . .	.10	6.40 P.M. to 1.30 A.M.
Apr. 19, . . .	.05	11.10 A.M. to 7.30 A.M.	Sept. 24, . . .	3.63	10.30 A.M. to 6.30 P.M.
Apr. 23, . . .	.05	2.10 A.M. to 3.55 A.M.	Sept. 25, . . .		
Apr. 24, . . .			Sept. 28, . . .		
Apr. 28, . . .			Sept. 29, . . .		
Apr. 29, . . .			Total, . . .	10.02	
May 1, . . .					
Total, . . .	3.72				

<sup>1</sup> Snow.<sup>2</sup> Rain and snow.

TABLE NO. 4.—*Rainfall in Inches at Chestnut Hill Reservoir in 1907—*  
Concluded.

DATE.	Amount.	Duration.	DATE.	Amount.	Duration.
Oct. 4, . . .	.49	4.40 A.M. to	Dec. 1, . . .	.06 <sup>1</sup>	8.30 A.M. to
Oct. 5, . . .	.05	11.00 P.M. to	Dec. 2, . . .	.35 <sup>1</sup>	1.20 A.M.
Oct. 5, . . .	.05	11.00 P.M. to	Dec. 4, . . .	.71	3.25 A.M. to 5.30 P.M.
Oct. 6, . . .	1.67	3.25 A.M. to 2.30 P.M.	Dec. 10, . . .	2.32 <sup>2</sup>	10.30 A.M. to 10.30 P.M.
Oct. 8, . . .	.47	5.10 A.M. to	Dec. 14, . . .	.93	11.45 A.M. to
Oct. 20, . . .	.76	2.45 A.M.	Dec. 15, . . .	.83	3.30 P.M.
Oct. 21, . . .	.21	5.55 A.M. to	Dec. 23, . . .	.83	10.15 A.M. to 9.00 P.M.
Oct. 28, . . .	.21	6.20 A.M.	Dec. 30, . . .		7.15 A.M. to
Oct. 29, . . .		3.15 P.M. to 7.00 P.M.	Dec. 31, . . .		1.25 A.M.
Total, . . .	3.65		Total, . . .	6.25	
Nov. 2, . . .	.95	4.45 P.M. to			
Nov. 3, . . .	2.37	6.40 A.M.			
Nov. 6, . . .	.05	6.30 A.M. to			
Nov. 7, . . .	.74	6.15 A.M.			
Nov. 7, . . .	.48	7.30 A.M. to 3.30 P.M.			
Nov. 10, . . .	.08	3.55 A.M. to			
Nov. 11, . . .	3.19	1.45 P.M.			
Nov. 18, . . .	.05	7.30 P.M. to			
Nov. 19, . . .		8.30 A.M.			
Nov. 21, . . .		8.15 A.M. to			
Nov. 22, . . .		5.05 A.M.			
Nov. 24, . . .		4.30 P.M. to			
Nov. 25, . . .		7.00 P.M.			
Nov. 26, . . .		3.15 P.M. to			
Nov. 27, . . .		12.10 A.M.			
Total, . . .	7.91				

Total for the year, 51.83 inches.

<sup>1</sup> Snow.<sup>2</sup> Rain and snow.



TABLE No. 5. — *Rainfall in Inches on the Wachusett Watershed, 1897 to 1907.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1897,	3.46	2.86	4.01	2.32	5.06	5.11	8.65	3.47	1.93	0.94	7.62	6.41	51.84
1898,	6.65	3.30	2.27	4.43	3.38	3.11	3.01	10.61	3.15	7.21	6.81	3.99	57.92
1899,	2.93	5.12	6.75	1.94	1.33	5.51	3.82	3.20	4.11	2.72	1.94	2.03	41.40
1900,	4.56	8.69	6.19	2.76	4.31	3.59	3.20	3.18	3.46	2.90	6.41	3.15	52.46
1901,	1.75	1.13	5.82	9.64	7.02	1.51	5.66	4.58	3.10	3.70	2.43	9.36	55.70
1902,	2.72	4.91	5.27	4.36	2.24	2.51	3.87	3.95	4.26	6.36	0.93	7.20	48.58
1903,	2.85	4.42	6.58	3.10	1.24	10.37	3.43	3.88	2.93	4.43	2.36	3.99	49.58
1904,	4.02	2.66	3.40	7.45	2.99	3.44	3.84	3.68	5.30	1.78	1.62	2.88	43.06
1905,	6.10	1.72	3.95	2.60	0.83	4.88	5.39	3.09	6.90	1.81	2.52	3.79	43.58
1906,	2.59	2.71	5.17	3.12	6.58	5.95	5.52	4.34	2.61	3.95	2.25	4.26	49.08
1907,	2.84	2.32	1.82	2.65	2.96	3.54	3.03	1.26	9.50	5.68	5.74	4.40	45.74
Total,	40.47	39.87	51.23	44.37	37.97	49.52	49.42	45.24	47.25	41.48	40.66	51.46	538.94
Average (11 years),	3.68	3.62	4.66	4.03	3.45	4.50	4.49	4.11	4.30	3.77	3.70	4.68	48.49

NOTE. — The figures tabulated are means of observations at four places, as follows: January, 1897, to December, 1900, Princeton, Jefferson, Sterling and South Clinton; January, 1901, to December, 1907, Princeton, Jefferson, Sterling and Boylston.

TABLE No. 6. — *Rainfall in Inches on the Sudbury Watershed,<sup>1</sup> 1875 to 1907.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1875.	2.42	3.15	3.74	3.23	3.56	6.24	3.57	5.53	3.43	4.85	4.83	0.94	45.49
1876.	1.83	4.21	7.43	4.20	2.76	2.04	9.13	1.72	4.62	2.24	5.76	3.62	49.56
1877.	3.22	6.74	8.36	3.43	3.70	2.43	2.95	3.68	0.32	8.52	5.80	5.02	41.02
1878.	5.63	5.97	4.69	5.79	0.96	3.88	2.97	6.94	1.29	6.42	7.02	6.37	57.33
1879.	2.48	3.66	5.14	4.72	1.58	3.79	3.93	6.51	1.88	0.81	2.68	4.34	41.42
1880.	3.57	3.98	3.31	3.11	1.84	2.14	6.27	4.01	1.60	3.74	1.78	2.83	38.18
1881.	4.56	4.65	5.73	2.00	3.51	5.39	2.35	1.36	2.62	2.95	4.09	3.96	44.17
1882.	5.95	4.55	2.65	1.82	5.07	1.66	1.77	8.74	2.07	2.07	1.15	2.30	39.40
1883.	1.82	3.87	1.78	1.84	4.19	2.40	2.68	0.73	1.52	5.60	1.81	3.55	32.78
1884.	5.09	6.54	4.72	4.41	3.47	3.44	3.67	4.65	0.85	2.48	2.65	5.17	47.14
1885.	4.71	3.87	1.07	3.60	3.48	2.87	1.93	7.18	1.43	5.09	6.09	2.72	43.54
1886.	6.36	6.28	3.61	2.22	3.60	1.47	3.27	4.10	2.00	3.24	4.64	4.07	46.06
1887.	5.20	4.78	4.30	4.21	1.16	2.65	3.76	5.28	1.32	2.83	2.67	3.88	42.70
1888.	4.13	3.68	6.02	2.43	4.82	2.54	1.41	6.22	8.59	4.99	7.22	5.40	57.47
1889.	5.37	1.65	2.37	3.41	2.95	2.80	8.94	4.18	4.60	4.25	6.29	3.14	49.95
1890.	2.53	3.51	7.73	2.64	5.21	2.03	2.46	3.87	6.00	10.51	1.20	5.31	55.00
1891.	7.02	5.23	6.48	3.91	2.01	3.77	3.39	4.73	2.38	3.83	3.09	3.68	49.62
1892.	5.85	3.14	4.06	0.83	5.58	2.76	4.23	4.44	2.84	1.07	5.80	1.13	41.83
1893.	2.92	8.20	3.67	3.60	6.61	2.38	2.57	5.41	1.74	4.07	2.20	4.86	48.23
1894.	4.03	3.91	1.43	3.42	4.24	1.15	3.26	2.03	2.63	5.34	3.43	4.81	39.74
1895.	4.06	1.39	2.98	5.25	2.02	2.77	5.04	4.15	2.30	10.68	6.63	3.25	59.62
1896.	2.29	7.18	5.24	1.57	2.57	3.22	2.51	2.40	7.72	3.76	3.02	2.12	43.70
1897.	4.00	2.91	3.66	2.82	4.37	4.46	5.41	3.51	2.94	0.47	6.40	5.21	46.19
1898.	6.83	4.49	2.40	4.66	3.22	2.48	4.09	8.17	2.62	6.71	6.35	3.28	59.88
1899.	4.18	4.91	7.01	1.90	1.45	2.51	3.22	1.43	3.35	2.69	2.18	1.78	37.21
1900.	4.06	9.14	6.35	2.99	4.32	2.42	2.26	2.26	3.36	3.83	5.70	2.74	59.65
1901.	1.82	1.02	6.57	8.60	7.23	1.38	5.71	4.57	3.30	2.82	2.90	9.69	56.11
1902.	2.62	6.18	5.34	4.13	1.86	4.13	2.94	3.40	4.54	4.44	1.45	6.38	46.07
1903.	3.80	3.95	6.63	2.99	0.93	9.25	2.77	3.67	1.75	4.72	1.56	3.14	45.16
1904.	4.87	3.00	2.72	8.87	2.65	2.80	1.96	3.86	5.80	1.64	1.73	2.92	42.82
1905.	5.26	2.20	3.15	2.72	1.31	5.00	3.47	2.72	1.54	1.64	2.07	4.01	42.31
1906.	2.47	2.92	6.32	2.88	5.66	3.91	3.42	3.02	3.30	3.40	2.69	4.49	44.48
1907.	3.28	2.17	1.91	3.41	3.63	3.53	1.86	1.07	8.76	4.17	6.12	4.47	44.38
Total.	137.20	137.43	149.17	117.26	110.92	105.02	120.86	128.45	118.52	135.87	129.58	127.43	1,517.71
Average (33 years).	4.16	4.17	4.52	3.55	3.36	3.18	3.66	3.89	3.59	4.12	3.93	3.86	45.99

<sup>1</sup> Means of observations at several places, as follows: January, 1875, to April, 1876, Lake Cochituate; April to June, 1876, Lake Cochituate, Westborough and Hopkinton; June to December, 1876, Lake Cochituate, Southborough, Marlborough, Westborough and Hopkinton; December, 1876, to January, 1883, Framingham, Southborough, Marlborough, Westborough and Hopkinton; January, 1883, to January, 1884, Framingham and Southborough; January, 1884, to January, 1890, Framingham and Westborough; January, 1890, to May, 1898, Framingham and Ashland Dam; June, 1898, to December, 1907, Framingham, Ashland Dam, Corda-ville and Sudbury Dam.

TABLE No. 7.—*Yield of the Wachusett Watershed in Gallons per Day per Square Mile<sup>1</sup> from 1897 to 1907.*

MONTH.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	Mean for 11 Years, 1897-1907.
January, . . . . .	796,000	1,563,000	2,092,000	796,000	519,000	1,676,000	1,265,000	659,000	1,266,000	1,132,000	1,458,000	1,202,000
February, . . . . .	931,000	1,635,000	1,090,000	4,054,000	356,000	1,401,000	2,133,000	927,000	452,000	1,027,000	692,000	1,335,000
March, . . . . .	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,992,000	3,423,000	3,008,000	3,004,000	1,860,000	1,697,000	2,913,000
April, . . . . .	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000	2,159,000	2,238,000	2,981,000	1,617,000	2,109,000	1,436,000	2,376,000
May, . . . . .	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,031,000	563,000	1,498,000	445,000	1,532,000	965,000	1,223,000
June, . . . . .	1,181,000	828,000	561,000	578,000	985,000	410,000	2,131,000	762,000	542,000	1,184,000	773,000	903,000
July, . . . . .	1,442,000	333,000	354,000	217,000	477,000	292,000	624,000	497,000	365,000	728,000	335,000	515,000
August, . . . . .	896,000	1,325,000	236,000	197,000	512,000	297,000	474,000	355,000	321,000	591,000	87,000	481,000
September, . . . . .	380,000	676,000	250,000	127,000	320,000	241,000	375,000	494,000	1,228,000	277,000	810,000	471,000
October, . . . . .	243,000	1,509,000	245,000	282,000	647,000	950,000	689,000	347,000	367,000	530,000	1,382,000	654,000
November, . . . . .	1,283,000	2,170,000	430,000	875,000	517,000	635,000	634,000	343,000	442,000	740,000	2,540,000	965,000
December, . . . . .	2,275,000	2,061,000	359,000	1,570,000	3,234,000	1,848,000	954,000	440,000	1,018,000	794,000	1,961,000	1,501,000
Average for year, . . . . .	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000	1,248,000	1,285,000	1,025,000	926,000	1,043,000	1,180,000	1,212,000
Average for driest 6 months*, . . . . .	886,000	1,013,000	312,000	377,000	576,000	471,000	626,000	413,000	541,000	613,000	725,000	663,000

<sup>1</sup> The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent. of the whole area from 1897 to 1902, inclusive, to 2.4 per cent. in 1903, to 3.6 per cent. in 1904, to 4.1 per cent. in 1905, to 5.1 per cent. in 1906, and to 6.0 per cent. in 1907.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile<sup>1</sup> from 1875 to 1907.*

MONTH.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
January, . . . . .	103,000	643,000	658,000	1,810,000	700,000	1,120,000	415,000	1,241,000	335,000	995,000	1,235,000
February, . . . . .	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000
March, . . . . .	1,604,000	4,433,000	4,814,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000
April, . . . . .	3,049,000	3,202,000	2,394,000	1,026,000	3,116,000	1,103,000	1,546,000	867,000	1,350,000	2,883,000	1,815,000
May, . . . . .	1,188,000	1,138,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000	437,000	1,030,000	1,336,000
June, . . . . .	870,000	222,000	597,000	506,000	413,000	175,000	1,335,000	520,000	300,000	416,000	426,000
July, . . . . .	321,000	183,000	202,000	128,000	137,000	176,000	276,000	86,000	115,000	224,000	62,000
August, . . . . .	336,000	405,000	121,000	476,000	335,000	119,000	148,000	55,000	79,000	257,000	240,000
September, . . . . .	207,000	184,000	60,000	161,000	141,000	80,000	197,000	307,000	91,000	44,000	121,000
October, . . . . .	646,000	234,000	631,000	516,000	71,000	102,000	186,000	299,000	186,000	83,000	336,000
November, . . . . .	1,302,000	1,088,000	1,418,000	1,633,000	206,000	205,000	395,000	209,000	205,000	175,000	1,177,000
December, . . . . .	584,000	453,000	1,220,000	3,177,000	463,000	175,000	775,000	315,000	194,000	925,000	1,174,000
Average for year, . . . . .	972,000	1,137,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000	533,000	1,129,000	901,000
Average for driest 6 months, . . . . .	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000	145,000	200,000	391,000

<sup>1</sup> The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent. in 1884 and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

TABLE No. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile<sup>1</sup> from 1875 to 1907* — Continued.

	Month.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.
January,	. . . . .	1,461,000	2,589,000	1,053,000	2,782,000	1,354,000	3,018,000	1,870,000	434,000	638,000	1,034,000	1,084,000
February,	. . . . .	4,801,000	2,829,000	1,950,000	1,196,000	1,529,000	3,486,000	943,000	1,542,000	991,000	541,000	2,676,000
March,	. . . . .	2,059,000	2,868,000	3,298,000	1,338,000	3,613,000	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000
April,	. . . . .	1,947,000	2,020,000	2,615,000	1,410,000	1,875,000	2,397,000	871,000	2,125,000	1,640,000	2,515,000	1,494,000
May,	. . . . .	729,000	1,009,000	1,632,000	880,000	1,366,000	583,000	1,259,000	2,883,000	840,000	636,000	360,000
June,	. . . . .	203,000	413,000	421,000	653,000	568,000	413,000	428,000	440,000	419,000	174,000	339,000
July,	. . . . .	116,000	115,000	117,000	634,000	107,000	149,000	214,000	158,000	161,000	231,000	95,000
August,	. . . . .	94,000	214,000	379,000	1,432,000	132,000	163,000	280,000	181,000	209,000	229,000	57,000
September,	. . . . .	117,000	111,000	1,155,000	823,000	457,000	203,000	229,000	108,000	150,000	89,000	388,000
October,	. . . . .	146,000	190,000	1,909,000	1,230,000	2,272,000	210,000	126,000	222,000	374,000	1,373,000	592,000
November,	. . . . .	673,000	369,000	2,738,000	1,941,000	1,215,000	305,000	697,000	319,000	836,000	2,777,000	659,000
December,	. . . . .	1,020,000	643,000	3,043,000	2,241,000	996,000	544,000	485,000	796,000	716,000	1,782,000	657,000
Average for year,	. . . . .	1,087,000	1,154,000	1,697,000	1,383,000	1,285,000	1,315,000	781,000	1,037,000	770,000	1,152,000	1,019,000
Average for driest 6 months,	. . . . .	223,000	234,000	953,000	944,000	747,000	239,000	327,000	237,000	356,000	460,000	314,000

<sup>1</sup> The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent. in 1894 and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

TABLE NO. 8. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile<sup>1</sup> from 1875 to 1907* — Concluded.

MONTH.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	Mean for 33 Years, 1875-1907.
January,	845,000	1,638,000	2,288,000	794,000	437,000	1,763,000	1,733,000	477,000	1,410,000	1,125,000	1,351,000	1,224,000
February,	1,067,000	3,022,000	1,381,000	3,800,000	300,000	1,674,000	2,279,000	882,000	330,000	1,041,000	624,000	1,753,000
March,	2,565,000	2,604,000	4,205,000	3,654,000	2,755,000	4,199,000	3,454,000	2,989,000	2,497,000	2,409,000	1,658,000	2,914,000
April,	1,515,000	1,829,000	2,621,000	1,350,000	4,204,000	1,885,000	2,261,000	3,294,000	1,643,000	1,949,000	1,607,000	2,081,000
May,	915,000	1,246,000	511,000	1,312,000	2,954,000	743,000	351,000	1,745,000	297,000	1,659,000	888,000	1,106,000
June,	982,000	530,000	66,000	316,000	753,000	303,000	1,987,000	419,000	467,000	707,000	761,000	533,000
July,	638,000	231,000	19,000	—18,000	306,000	66,000	445,000	62,000	177,000	398,000	9,000	193,000
August,	591,000	1,107,000	—35,000	—34,000	424,000	135,000	307,000	170,000	114,000	180,000	—104,000	270,000
September,	182,000	369,000	94,000	65,000	305,000	178,000	130,000	397,000	1,246,000	19,000	541,000	271,000
October,	94,000	1,160,000	115,000	186,000	412,000	506,000	492,000	191,000	158,000	301,000	741,000	496,000
November,	909,000	1,986,000	304,000	663,000	474,000	444,000	363,000	289,000	279,000	483,000	1,998,000	873,000
December,	1,584,000	1,799,000	220,000	1,096,000	2,635,000	1,779,000	582,000	263,000	887,000	659,000	2,032,000	1,092,000
Average for year,	991,000	1,450,000	973,000	1,082,000	1,342,000	1,140,000	1,190,000	931,000	755,000	866,000	1,010,000	1,063,000
Average for driest six months,	564,000	777,000	93,000	194,000	445,000	271,000	388,000	228,000	403,000	341,000	471,000	438,000

<sup>1</sup> The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent. in 1894 and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.



TABLE No. 9. — *Wachusett System. — Statistics of Flow of Water, Storage and Rainfall in 1907.*  
 [Watershed above gaging station = 119.00 square miles.]

MONTH.	Quantity of Water dis- charged through Wachusett Aqueduct (Gal- lons per Day).	Quantity of Water wasted into River below Dam (Gallons per Day).	STORAGE. <sup>1</sup>		Total Yield (Gallons per Day).	Rainfall (Inches).	Rainfall collected (Inches).	Percent- age of Rainfall collected.
			Gain (Gallons per Day).	Loss (Gallons per Day).				
January, . . . . .	91,655,000	3,887,000	78,019,000	-	173,561,000	2.84	2.601	91.6
February, . . . . .	108,407,000	3,604,000	-	29,686,000	82,325,000	2.32	1.115	48.0
March, . . . . .	83,090,000	3,752,000	115,152,000	-	201,994,000	1.82	3.028	166.3
April, . . . . .	106,310,000	3,813,000	60,733,000	-	170,857,000	2.65	2.479	93.5
May, . . . . .	123,406,000	3,758,000	-	12,271,000	114,894,000	2.96	1.722	58.2
June, . . . . .	81,177,000	4,357,000	6,470,000	-	92,003,000	3.54	1.334	37.7
July, . . . . .	100,071,000	4,355,000	-	64,581,000	39,845,000	3.63	0.597	19.7
August, . . . . .	84,587,000	3,142,000	-	77,361,000	10,368,000	1.26	0.155	12.4
September, . . . . .	47,020,000	3,743,000	45,657,000	-	96,420,000	9.50	1.399	14.7
October, . . . . .	52,490,000	4,158,000	107,806,000	-	164,455,000	5.68	2.465	43.4
November, . . . . .	52,963,000	4,600,000	244,663,000	-	302,927,000	5.74	4.384	76.4
December, . . . . .	61,010,000	4,548,000	167,855,000	-	233,413,000	4.40	3.499	79.5
Total, . . . . .	-	-	-	-	-	45.74	24.778	-
Average for year, . . . . .	82,589,000	3,978,000	53,829,000	-	140,396,000	-	-	54.2

<sup>1</sup> Aggregate storage in Wachusett Reservoir and in ponds and mill reservoirs.

TABLE No. 10. — *Sudbury System. — Statistics of Flow of Water, Storage and Rainfall in 1907.*

[Watershed from 1875 to 1878 inclusive = 77,764 square miles; in 1879 and 1880 = 78,238 square miles; and from 1881 to 1907 inclusive = 75.2 square miles.]

MONTH.	Quantity of Water received through Wachuset Aqueduct (Gallons per Day).	Quantity of Water discharged through Sudbury Aqueduct (Gallons per Day).	Quantity of Water discharged through Weston Aqueduct (Gallons per Day). <sup>1</sup>	Quantity of Water used by Framingham Water Company (Gallons per Day).	Quantity of Water diverted from Sewers, etc. (Gallons per Day).	Quantity of Water wasted into River below Lowell Dam (Gallons per Day).	STORAGE.		Total Yield of Watershed (Gallons per Day).	Rainfall collected (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
							Gain (Gallons per Day).	Loss (Gallons per Day).				
January, . . .	91,455,000	97,942,000	31,452,000	645,000	1,765,000	71,981,000	—	10,506,000	101,025,000	3.28	2.411	73.4
February, . . .	108,407,000	103,046,000	31,521,000	725,000	1,361,000	51,111,000	—	32,454,000	46,304,000	2.17	1.065	46.3
March, . . .	83,030,000	90,226,000	30,751,000	632,000	1,961,000	64,665,000	19,545,000	—	124,390,000	1.91	2.958	154.6
April, . . .	106,310,000	92,777,000	29,070,000	657,000	1,963,000	72,303,000	39,407,000	—	120,867,000	3.41	2.774	81.5
May, . . .	123,406,000	92,452,000	30,245,000	597,000	1,261,000	27,848,000	37,761,000	—	66,758,000	3.63	1.584	43.6
June, . . .	84,177,000	84,020,000	31,187,000	610,000	1,100,000	23,640,000	—	2,123,000	57,257,000	3.53	1.314	37.2
July, . . .	100,071,000	80,881,000	31,055,000	639,000	539,000	1,500,000	—	13,881,000	661,000	1.86	0.015	0.9
August, . . .	84,587,000	77,890,000	30,771,000	661,000	452,000	1,500,000	—	34,526,000	—7,839,000	1.07	—0.186	—17.4
September, . . .	47,020,000	73,027,000	29,453,000	590,000	730,000	1,500,000	—	18,277,000	40,683,000	8.76	0.934	10.7
October, . . .	52,490,000	84,942,000	30,126,000	574,000	1,045,000	1,513,000	—	10,010,000	55,700,000	4.17	1.321	31.7
November, . . .	52,963,000	73,730,000	29,757,000	547,000	1,717,000	59,003,000	41,470,000	—	150,260,000	6.12	3.430	56.4
December, . . .	61,010,000	88,568,000	29,446,000	494,000	2,081,000	73,110,000	20,116,000	—	152,774,000	4.47	3.624	81.1
Total, . . .	—	—	—	—	—	—	—	—	—	44.38	21.204	—
Av. for year,	82,589,000	86,553,000	30,438,000	613,000	1,333,000	37,696,000	2,463,000	—	75,918,000	—	—	47.8

<sup>1</sup> Including quantity of water wasted from aqueduct.

TABLE No. 11.—*Cochituate System. — Statistics of Flow of Water, Storage and Rainfall in 1907.*  
 [Watershed of Lake = 18.87 square miles.]

Month.	Quantity of Water received from External Sources (Gallons per Day). <sup>2</sup>	Quantity of Water discharged through Cochituate Aqueduct (Gallons per Day).	Quantity of Water diverted from Wastewater Sowers, etc. (Gallons per Day).	Quantity of Water wasted at Outlet (Gallons per Day).	Storage.		Total Yield of Water-shed (Gallons per Day).	Rainfall collected (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
					Gain (Gallons per Day).	Loss (Gallons per Day).				
January,	—	—	781,000	—	19,284,000	—	20,065,000	3.14	1.90	60.4
February,	—	6,568,000	533,000	—	3,846,000	—	11,007,000	2.18	0.94	43.1
March,	—	14,439,000	877,000	—	9,816,000	—	25,132,000	1.88	2.38	126.4
April,	—	6,237,000	1,203,000	7,147,000	9,363,000	—	23,950,000	3.47	2.19	63.1
May,	—	—	774,000	14,325,000	—	—	15,100,000	3.62	1.43	39.4
June,	—	8,203,000	537,000	6,900,000	—	4,700,000	11,000,000	2.89	1.01	34.8
July,	—	15,484,000	374,000	—	—	14,545,000	1,313,000	1.45	0.12	8.6
August,	—	24,116,000	184,000	—	—	21,225,000	3,077,000	1.27	0.29	22.9
September,	—	20,100,000	263,000	—	—	8,753,000	11,610,000	7.62	1.06	13.9
October,	9,748,000	18,690,000	526,000	—	2,497,000	—	11,905,000	3.96	1.13	28.6
November,	13,020,000	20,610,000	1,090,000	—	20,113,000	—	28,793,000	5.63	2.63	46.8
December,	—	3,339,000	1,226,000	—	25,823,000	—	30,387,000	3.66	2.87	78.5
Total,	—	—	—	—	—	—	—	40.77	17.95	—
Average for year,	1,898,000	11,497,000	707,000	2,371,000	3,451,000	—	16,129,000	—	—	44.0

<sup>1</sup> Not including the watershed of Dudley Pond.

<sup>2</sup> From Framingham reservoirs Nos. 1, 2 and 3.

TABLE No. 12. — *Elevations of Water Surfaces of Reservoirs above Boston City Base at the Beginning of Each Month.*

DATE.	Chestnut Hill Reservoir. Ordinary High Water = 134.00.	Lake Cochituate. High Water = 144.36.	Farm Pond. High Water = 159.25.	Spot Pond. High Water = 163.00.	Weston Reservoir. High Water = 200.00.	FRAMINGHAM RESERVOIR.			Ashland Reservoir. Flash Boards = 225.23.	Sudbury Reservoir. Flash Boards = 259.97.	Hopkinton Reservoir. Flash Boards = 305.00.	Whitehall Reservoir. Ordinary High Water = 337.91.	Wachusett Reservoir. Ordinary High Water = 385.00.
						No. 1. Flash Boards = 169.27.	No. 2. Flash Boards = 177.12.	No. 3. Flash Boards = 186.50.					
Jan. 1, 1907, .	131.46	138.56	159.22	162.89	200.26	168.31	176.56	183.69	224.80	256.45	303.00	337.05	384.57
Feb. 1, 1907, .	131.99	141.45	159.24	162.27	200.03	167.84	176.17	183.90	224.46	255.88	301.22	336.35	367.30
Mar. 1, 1907, .	132.69	141.94	159.16	159.79	200.03	167.85	176.17	183.09	221.96	255.14	301.01	335.19	366.54
April 1, 1907, .	133.12	143.27	159.08	160.91	200.03	167.85	176.19	183.23	224.22	255.51	304.18	335.92	370.28
May 1, 1907, .	134.08	144.39	158.98	162.44	200.02	167.85	176.18	184.00	224.54	257.09	304.25	336.98	372.32
June 1, 1907, .	134.19	144.39	158.87	163.25	199.92	169.50	177.85	183.61	225.39	259.22	305.25	337.48	372.02
July 1, 1907, .	133.23	143.84	158.68	163.21	200.08	169.21	176.61	182.56	225.38	259.33	305.12	337.80	372.41
Aug. 1, 1907, .	131.59	141.91	158.25	163.20	200.05	168.57	176.31	183.65	224.61	259.16	299.93	337.55	370.47
Sept. 1, 1907, .	131.69	138.77	157.79	163.20	200.08	168.20	176.11	183.45	211.98	259.17	291.38	337.18	368.07
Oct. 1, 1907, .	132.68	137.38	158.20	163.26	200.24	169.31	176.81	184.35	200.69	259.44	280.62	337.79	368.91
Nov. 1, 1907, .	133.73	137.80	158.28	163.10	200.08	169.20	177.80	182.12	203.49	258.44	284.25	337.89	372.52
Dec. 1, 1907, .	131.96	140.81	158.65	163.19	200.04	167.92	177.44	182.08	212.49	259.48	293.18	338.26	379.81
Jan. 1, 1908, .	131.05	144.27	158.99	163.04	200.00	168.01	176.31	182.20	220.48	259.65	300.66	337.63	384.31

TABLE NO. 13.—*Sources from which and Periods during which Water has been drawn for the Supply of the Metropolitan Water District.*

*From Wachusett Reservoir into Sudbury Reservoir.*

7:00 A.M. Jan. 1 to 11:00 A.M. Sept. 24.  
 9:00 A.M. Oct. 15 " 5:00 P.M. Nov. 2.  
 7:00 P.M. Nov. 6 " 10:00 A.M. Nov. 25.  
 12:00 M. Dec. 2 " 11:00 A.M. Dec. 11.  
 1:00 P.M. Dec. 14 " 12:00 M. Dec. 30.  
 Total quantity, 30,145,100,000 gallons.

*From Sudbury Reservoir through the Weston Aqueduct to the Weston Reservoir.*

7:00 A.M. Jan. 1 to 9:00 A.M. Feb. 13.  
 11:00 A.M. Feb. 13 " 6:30 A.M. Apr. 7.  
 7:00 A.M. Apr. 13 " 7:00 A.M. Jan. 1, 1908.  
 Total quantity, 11,077,600,000 gallons.

*From Framingham Reservoir No. 2 through Sudbury Aqueduct to Chestnut Hill Reservoir.*

7:00 A.M. May 14 to 12:00 M. Oct. 12.  
 Total quantity, 4,280,000,000 gallons.

*From Framingham Reservoir No. 3 through Sudbury Aqueduct to Chestnut Hill Reservoir.*

7:00 A.M. Jan. 1 to 12:00 M. Oct. 12.  
 1:15 P.M. Oct. 15 " 12:00 M. Nov. 2.  
 10:00 A.M. Nov. 6 " 7:00 A.M. Nov. 19.  
 2:45 P.M. Nov. 19 " 10:30 A.M. Nov. 22.  
 11:15 A.M. Nov. 22 " 7:00 A.M. Dec. 5.  
 3:00 P.M. Dec. 5 " 7:00 A.M. Jan. 1, 1908.  
 Total quantity, 26,619,000,000 gallons.

*From Lake Cochituate through Cochituate Aqueduct to Chestnut Hill Reservoir.*

1:00 P.M. Feb. 12 to 4:00 P.M. Apr. 9.  
 7:00 A.M. June 12 " 7:00 A.M. June 25.  
 4:00 P.M. July 11 " 7:00 P.M. July 11.  
 7:00 A.M. July 12 " 7:30 A.M. July 20.  
 8:30 A.M. July 20 " 7:15 A.M. Nov. 8.  
 5:15 P.M. Nov. 8 " 5:00 P.M. Dec. 6.  
 Total quantity, 4,160,300,000 gallons.

*From Framingham Reservoir No. 1 to Lake Cochituate.*

2:00 P.M. Oct. 12 to 10:30 A.M. Oct. 15.  
 1:45 P.M. Nov. 2 " 7:00 A.M. Nov. 6.  
 Total quantity, 344,300,000 gallons.

*From Framingham Reservoir No. 2 to Lake Cochituate.*

2:00 P.M. Oct. 12 to 10:30 A.M. Oct. 15.  
 1:45 P.M. Nov. 2 " 7:00 A.M. Nov. 6.  
 Total quantity, 311,200,000 gallons.

*From Framingham Reservoir No. 3 to Lake Cochituate.*

10:30 A.M. Oct. 15 to 11:30 A.M. Oct. 15.

7:00 A.M. Nov. 6 " 8:00 A.M. Nov. 6.

Total quantity, 37,300,000 gallons.

*From Hopkinton Reservoir to Framingham Reservoir No. 2.*

12:00 M. July 11 to 11:20 A.M. Sept. 23.

10:30 A.M. Sept. 25 " 10:40 A.M. Sept. 29.

Total quantity, 1,165,400,000 gallons.

*From Ashland Reservoir to Framingham Reservoir No. 2.*

5:30 P.M. July 23 to 7:00 A.M. July 27.

11:00 A.M. Aug. 2 " 11:00 A.M. Sept. 4.

11:00 A.M. Sept. 5 " 10:30 A.M. Sept. 10.

10:00 A.M. Sept. 11 " 11:00 A.M. Sept. 23.

10:30 A.M. Sept. 25 " 7:00 A.M. Sept. 29

Total quantity, 1,222,900,000 gallons.



TABLE No. 14. — *Average Daily Quantity of Water flowing through Aque ducts in 1907 by Months.*<sup>1</sup>

Month.	Wachusett Aque duct into Sudbury Reservoir. (Gallons).	Weston Aque duct into Metro- politan District (Gallons).	SUDBURY AQUE DUCT INTO CHESTNUT HILL RESERVOIR.			Cochituate Aque duct into Chestnut Hill Reservoir (Gallons).
			From Framingham Reservoir No. 3 (Gallons).	From Framingham Reservoir No. 2 (Gallons).	Total (Gallons).	
January, . . . . .	91,655,000	31,452,000	97,942,000	—	97,942,000	—
February, . . . . .	108,407,000	31,521,000	130,046,000	—	103,046,000	6,508,000
March, . . . . .	83,090,000	30,752,000	90,226,000	—	90,226,000	14,439,000
April, . . . . .	106,310,000	27,993,000	92,777,000	—	92,777,000	5,567,000
May, . . . . .	123,406,000	30,245,000	84,571,000	7,881,000	92,452,000	—
June, . . . . .	81,177,000	31,187,000	67,720,000	16,300,000	84,020,000	8,203,000
July, . . . . .	100,071,000	31,055,000	61,116,000	13,765,000	80,881,000	15,484,000
August, . . . . .	84,587,000	30,771,000	39,384,000	38,506,000	77,890,000	24,116,000
September, . . . . .	47,020,000	29,953,000	29,967,000	43,060,000	73,027,000	20,100,000
October, . . . . .	52,430,000	30,126,000	60,726,000	14,688,000	75,414,000	18,690,000
November, . . . . .	52,963,000	29,757,000	60,710,000	—	60,710,000	20,413,000
December, . . . . .	61,010,000	29,416,000	88,568,000	—	88,568,000	3,010,000
Average, . . . . .	82,583,000	30,350,000	72,929,000	11,726,000	84,655,000	11,398,000

<sup>1</sup> Not including quantities wasted while cleaning and repairing aqueducts, and not including 1,898,000 gallons per day diverted through the Sudbury Aqueduct to Lake Cochituate, and 2,740 gallons per day diverted to Farm Pond.

TABLE No. 15. — *Statement of Operations of Engines Nos. 1 and 2 at Chestnut Hill High-service Pumping Station for the Year 1907.*  
 [3 per cent. allowed for slip.]

MONTH.	ENGINE NO. 1.		ENGINE NO. 2.		Total Amount pumped (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).		Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Total Pumping Time.	Amount pumped, corrected for Slip (Million Gallons).	Total Pumping Time.	Amount pumped, corrected for Slip (Million Gallons).						No. 1.	No. 2.		
January, . . . . .	Hrs. Min.	60.63	Hrs. Min.	128.11	188.74	365,470	46,643	12.8	516.43	123.09	122.35	52,700,000	54,340,000
February, . . . . .	161 05		340 50										
March, . . . . .	280 50	105.35	308 10	114.58	219.93	398,807	56,354	11.1	551.47	124.45	124.86	57,260,000	59,040,000
April, . . . . .	93 20	34.75	402 45	147.41	182.16	314,734	40,861	13.0	578.77	126.74	124.70	60,310,000	62,190,000
May, . . . . .	55 25	20.35	313 30	113.31	133.66	215,613	24,710	11.5	619.91	120.57	122.11	62,930,000	64,590,000
June, . . . . .	63 50	23.25	328 25	122.57	145.82	212,307	23,828	11.2	686.84	120.25	121.87	69,580,000	71,740,000
July, . . . . .	250 40	89.67	221 10	79.20	168.87	216,007	26,014	12.0	781.78	120.46	120.85	78,570,000	81,010,000
August, . . . . .	- - -	-	628 15	223.62	223.62	280,822	34,826	12.0	771.58	-	120.72	77,570,000	79,390,000
September, . . . . .	154 05	56.91	445 30	183.49	240.40	320,303	47,075	13.4	686.09	120.88	122.06	69,600,000	71,770,000
October, . . . . .	601 25	209.62	- - -	-	209.62	314,031	43,715	12.7	608.14	121.01	-	61,300,000	63,210,000
November, . . . . .	601 25	199.22	- - -	-	199.22	353,442	41,811	11.8	563.66	120.63	-	56,640,000	58,400,000
December, . . . . .	565 50	164.68	- - -	-	164.68	312,274	41,064	13.1	527.36	120.38	-	52,880,000	54,520,000
Total, . . . . .	480 -	158.97	3,048 35	1,112.29	158.97	296,148	35,502	13.3	597.30	118.87	-	59,140,000	60,980,000
Average, . . . . .	3,250 35	1,123.40			2,235.69	3,629,708	462,403	-	-	-	-	-	-
	- - -	-		-	-	-	-	12.7	614.25	121.15	122.15	62,240,000	64,180,000

TABLE No. 16. — *Statement of Operations of Engine No. 3 at Chestnut Hill High-service Pumping Station for the Year 1907.*

[7.5 per cent. allowed for slip.]

	Month.		Total Pumping Time.	Amount pumped, corrected for Slip (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting; corrected for slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Hrs.	Min.									
January, . . . . .	26	35		23.8	23,734	3,700	15.9	1,006.15	126.61	106,120,000	114,690,000
February, . . . . .											
March, . . . . .	52	45		48.88	49,088	5,352	10.9	985.76	131.10	108,740,000	117,490,000
April, . . . . .	28	50		27.12	26,514	3,148	11.9	1,022.86	129.38	110,240,000	119,110,000
May, . . . . .	30	20		28.72	30,368	2,884	9.4	945.73	134.98	106,340,000	114,900,000
June, . . . . .											
July, . . . . .											
August, . . . . .	29	20		25.69	25,394	3,279	12.8	1,003.75	130.47	109,690,000	117,870,000
September, . . . . .	6			5.47	5,910	950	16.1	925.55	122.92	94,770,000	102,400,000
October, . . . . .											
November, . . . . .	53	25		50.17	47,156	8,158	17.3	1,003.92	125.03	110,810,000	119,730,000
December, . . . . .											
Total, . . . . .	227	15		209.43	208,364	27,421					
Average, . . . . .							13.2	1,007.52	129.16	108,400,000	117,130,000

TABLE No. 17. — Statement of Operations of Engine No. 4 at Chestnut Hill High-service Pumping Station for the Year 1907.  
[3 per cent. allowed for slip.]

MONTH.	Total Pumping Time.	Amount pumped (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, corrected for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.	SUMMARY OF ENGINES Nos. 1, 2, 3 AND 4.	
										Total Amount received for Ship (Million Gallons).	Daily Average Amount pumped (Million Gallons).
January, . . . . .	Hrs. Min. 715 40	912.39	742,454	99,513	13.4	1,229.69	131.23	134,430,000	138,560,000	1,125.61	36.31
February, . . . . .	672 -	856.06	691,479	101,252	14.6	1,238.02	132.03	136,160,000	140,350,000	1,075.99	38.43
March, . . . . .	689 45	876.32	724,489	99,694	13.8	1,209.57	131.91	132,910,000	137,000,000	1,107.36	35.72
April, . . . . .	686 10	870.15	708,991	90,018	12.7	1,227.31	132.08	135,030,000	139,180,000	1,030.93	34.36
May, . . . . .	713 25	907.46	741,749	107,560	14.5	1,223.41	130.39	133,490,000	137,600,000	1,082.00	34.90
June, . . . . .	720 -	915.26	768,836	104,180	13.6	1,190.45	130.35	129,260,000	133,240,000	1,081.13	36.14
July, . . . . .	734 50	933.93	766,615	99,081	12.9	1,218.25	130.42	132,350,000	136,430,000	1,157.55	37.34
August, . . . . .	716 55	942.93	722,386	104,980	14.5	1,305.30	131.85	143,360,000	147,770,000	1,209.02	39.00
September, . . . . .	713 25	906.06	735,625	108,256	14.7	1,231.69	133.25	136,710,000	140,920,000	1,121.15	37.37
October, . . . . .	744 -	942.89	777,218	110,946	14.3	1,213.16	133.28	134,690,000	138,830,000	1,142.11	36.84
November, . . . . .	665 25	844.96	703,069	103,758	14.8	1,201.82	132.88	133,030,000	137,120,000	1,059.81	35.33
December, . . . . .	743 35	943.06	878,089	116,525	13.3	1,075.02	131.29	117,570,000	121,190,000	1,102.93	35.58
Total, . . . . .	8,515 10	10,832.97	8,961,000	1,245,763	-	-	-	-	-	13,298.59	-
Average, . . . . .	-	-	-	-	13.9	1,211.13	131.79	132,960,000	137,650,000	-	36.43

TABLE No. 18. — Statement of Operations of Engines Nos. 5, 6 and 7 at Chestnut Hill Low-service Pumping Station for the Year 1907.

[3 per cent. allowed for slip.]

Month.	ENGINE No. 5.		ENGINE No. 6.		ENGINE No. 7.		Total Amount pumped (Million Gallons).	Daily Average Amount pumped (Million Gallons).	Total Amount of Coal consumed (Pounds).	Per Cent. of Ashes and Chimneys.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	AVERAGE LIFT (FEET).			Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting; corrected for Slip.	Duty in Foot-pounds per Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Hrs. Min.	Total Pumping Time.	Amount pumped, corrected for Slip (Million Gallons).	Total Pumping Time.	Hrs. Min.	Amount pumped, corrected for Slip (Million Gallons).						Engine No. 5.	Engine No. 6.	Engine No. 7.		
January, .	250 55	304.52	855.96	631 05	633 35	825.85	1,986.33	64.075	904,765	13.0	2,135.41	59.52	59.37	58.93	108,280,000	111,580,000
February, .	438 48	533.17	792.85	640 35	485 19	593.84	1,919.87	68.566	865,835	14.2	2,217.35	59.83	57.01	57.75	107,170,000	110,440,000
March, .	484 35	579.88	815.52	677 -	571 15	688.85	2,084.25	67.234	942,260	12.1	2,211.97	62.11	61.44	61.81	113,780,000	117,250,000
April, .	525 -	623.65	808.92	682 45	823 20	386.98	1,819.55	60.452	764,034	13.1	2,381.50	54.90	54.76	56.75	109,570,000	112,910,000
May, .	269 50	316.33	677.93	553 45	651 -	797.77	1,792.03	57.807	755,046	13.3	2,373.40	53.18	54.47	53.45	106,780,000	110,040,000
June, .	657 10	815.09	1 29	1 40	675 40	836.10	1,652.59	55.087	686,320	14.3	2,407.90	53.16	53.65	52.80	106,230,000	109,500,000
July, .	520 30	626.60	491.51	403 25	547 40	668.57	1,789.68	57.732	769,790	14.9	2,324.90	56.16	54.74	55.45	107,490,000	110,770,000
August, .	530 15	650.17	650.63	525 50	436 35	538.87	1,839.67	59.344	790,646	12.8	2,326.79	57.50	58.62	55.93	111,320,000	114,720,000
September, .	684 10	808.02	775.82	649 25	-	-	1,583.84	52.795	636,900	14.7	2,486.80	50.47	50.89	-	104,970,000	108,170,000
October, .	701 25	848.67	790.34	656 15	-	-	1,648.01	53.162	653,530	15.6	2,521.71	50.17	51.00	-	106,230,000	109,470,000
November, .	616 15	748.00	673.60	553 55	42 40	49.55	1,471.15	49.038	626,090	15.6	2,349.74	47.77	48.33	42.79	93,680,000	96,540,000
December, .	669 30	807.44	803.67	606 35	-	-	1,611.11	51.971	662,045	15.2	2,433.54	48.56	48.20	-	98,070,000	101,060,000
Total, .	6,318 23	7,664.54	6,701 55	8,147.15	4,397 04	5,386.38	21,198.08	-	9,057,261	-	-	-	-	-	-	-
Average,	-	-	-	-	-	-	-	58.077	-	14.0	2,340.45	53.69	54.50	56.44	106,640,000	109,890,000

TABLE No. 19. — *Statement of Operations of Engines Nos. 8 and 9 at Spot Pond Pumping Station for the Year 1907.*

[Engine No. 8, 2.02 per cent. allowed for slip.]

Month.	Total Pumping Time.	Hrs. Min.	Amount pumped, corrected for Slip (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting; corrected for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.	SUMMARY FOR ENGINES Nos. 8 AND 9.	
											Total Amount pumped, corrected for Slip (Million Gallons).	Daily Average Amount pumped (Million Gallons).
January,	.	.	12.86	11,820	1,405	11.9	1,047.37	129.38	115,200,000	115,200,000		
April,	.	.	19.79	23,541	3,655	15.5	840.66	120.94	84,030,000	86,430,000		
September,	.	.	9.40	8,744	1,317	15.1	1,075.02	136.94	122,630,000	125,150,000		
Total or average,	.	30	41.57	44,105	6,377	14.5	942.52	127.07	99,770,000	101,830,000		

[Engine No. 9, 3 per cent. allowed for slip.]

[illegible]



TABLE NO. 20. — (Meter Basis.) *Average Daily Consumption of Water during the Year 1907, in the Cities and Towns supplied by the Metropolitan Water Works, including Boston, Somerville, Chelsea, Malden, Everett, Quincy, Medford, Melrose, Revere, Watertown, Arlington, Lexington, Milton, Stoneham, Winthrop, Swampscott, Belmont, Nahant and a Small Portion of Saugus. (For Consumption of Water in Whole Metropolitan Water District, see Table No. 23.)*

MONTH.	Average Daily Consumption (Gallons).	Estimated Population.	Consumption per Inhabitant (Gallons).
January, . . . . .	134,725,400	923,060	146
February, . . . . .	146,118,200	924,700	158
March, . . . . .	128,891,700	926,340	139
April, . . . . .	118,269,200	927,980	128
May, . . . . .	118,247,400	931,620	127
June, . . . . .	121,202,600	935,260	130
July, . . . . .	124,211,800	937,900	133
August, . . . . .	126,575,200	939,390	135
September, . . . . .	120,233,700	939,870	128
October, . . . . .	119,337,900	939,360	127
November, . . . . .	115,385,700	938,850	123
December, . . . . .	118,142,900	940,330	126
For the year, . . . . .	124,135,100	934,730	133

In addition to the above quantities, the United States Government Reservation on Peddocks Island was supplied with 18,068,000 gallons, equivalent to a daily average rate of 50,000 gallons.

TABLE NO. 21. — (Meter Basis.) *Average Daily Consumption of Water, in Gallons, from the Low-service System in 1907.*

MONTH.	SOUTHERN LOW SERVICE.	NORTHERN LOW SERVICE.	Total Low-service Consumption.
	Boston, excluding East Boston and Charlestown.	Portions of Charles- town, Somerville, Chelsea, Everett, Malden, Medford, East Boston and Arlington.	
January, . . . . .	56,889,400	32,780,800	89,670,200
February, . . . . .	61,227,100	36,600,300	97,827,400
March, . . . . .	54,231,600	30,080,200	84,311,800
April, . . . . .	49,334,300	26,064,000	75,403,300
May, . . . . .	48,809,100	26,013,200	74,822,300
June, . . . . .	48,809,600	26,944,700	75,754,300
July, . . . . .	49,538,400	27,365,000	76,903,400
August, . . . . .	49,248,000	28,353,600	77,601,600
September, . . . . .	48,309,900	26,320,000	74,629,900
October, . . . . .	49,279,400	25,818,400	75,097,800
November, . . . . .	47,986,800	24,745,800	72,732,600
December, . . . . .	48,756,400	26,419,300	75,175,700
For the year, . . . . .	50,973,100	28,069,200	79,042,300

TABLE NO. 22. — (Meter Basis.) *Average Daily Consumption of Water, in Gallons, from the High-service and Extra High-service Systems in 1907.*

MONTH.	SOUTHERN HIGH SERVICE.	SOUTHERN EXTRA HIGH SERVICE.	NORTHERN HIGH SERVICE.	NORTHERN EXTRA HIGH SERVICE.
	Quincy, Water- town, Belmont, and Portions of Boston and Milton.	Portions of Boston and Milton.	Revere, Winthrop, Swampscott, Nahant, Stoneham, Melrose, and Portions of Boston, Chelsea, Everett, Malden, Medford, Somerville, and Small Part of Saugus.	Lexington and Portion of Arlington.
January, . . . . .	35,210,900	479,300	8,802,600	562,400
February, . . . . .	37,297,200	510,000	9,877,200	606,400
March, . . . . .	34,738,000	526,900	8,723,700	591,300
April, . . . . .	33,469,700	541,500	8,270,700	584,000
May, . . . . .	33,761,200	594,500	8,441,300	628,100
June, . . . . .	34,623,700	724,900	9,430,700	669,000
July, . . . . .	35,666,400	763,900	10,153,300	724,800
August, . . . . .	36,630,500	843,100	10,636,500	863,500
September, . . . . .	35,301,200	645,400	8,995,300	661,900
October, . . . . .	34,952,400	563,800	8,127,900	596,000
November, . . . . .	33,814,400	468,400	7,770,700	599,600
December, . . . . .	34,140,400	468,400	7,813,700	544,700
For the year, . . . . .	34,949,500	595,600	8,911,900	635,800

TABLE No. 23. — Average Daily Consumption of Water in Cities and Towns supplied from Metropolitan Works, as measured by Venturi Meters in 1907.

City or town,	Population supplied,	MONTH.	BOSTON.		SOMERVILLE.		MALDEN.		CHELSEA.		EVERETT.		QUINCY.		MEDFORD.	
			612,580.		72,510.		39,820.		38,650.		31,350.		29,390.		20,700.	
			GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
			Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,	.	.	105,697,600	174	7,163,000	100	1,896,500	48	4,966,300	130	2,938,700	96	2,788,700	97	2,161,400	106
February,	.	.	113,367,800	187	8,046,900	112	2,041,900	52	5,999,100	156	3,523,400	114	2,888,200	100	2,317,400	113
March,	.	.	101,347,800	167	6,320,400	88	1,863,200	48	4,400,700	115	2,750,600	89	2,862,000	99	2,169,400	106
April,	.	.	92,340,300	152	6,295,900	87	1,857,400	47	3,583,100	93	2,418,500	78	2,747,200	94	2,079,900	101
May,	.	.	92,031,500	151	6,376,400	88	1,807,100	46	3,362,300	87	2,368,400	76	2,857,100	98	2,142,100	104
June,	.	.	92,655,300	152	6,756,200	93	2,046,100	51	3,390,600	88	2,435,400	80	3,140,600	107	2,283,200	111
July,	.	.	94,162,000	154	6,751,600	93	2,063,000	52	3,451,300	89	2,500,800	80	3,380,800	115	2,322,300	112
August,	.	.	95,412,000	156	6,643,900	91	2,038,800	51	3,379,300	87	2,588,500	82	3,606,700	122	2,414,200	116
September,	.	.	92,919,800	151	6,268,600	86	1,782,000	45	3,304,400	85	2,448,100	78	3,160,900	107	2,120,400	102
October,	.	.	93,543,000	152	6,207,600	85	1,642,900	41	3,197,300	82	2,304,900	73	3,055,900	103	2,069,400	99
November,	.	.	91,141,800	148	5,857,700	80	1,620,800	40	3,063,100	79	2,142,000	68	2,767,300	93	2,009,700	96
December,	.	.	93,721,000	152	6,016,800	82	1,618,000	40	3,196,500	82	2,238,200	71	2,704,200	91	2,000,200	96
For the year,	.	.	96,422,800	157	6,548,400	90	1,857,100	47	3,761,000	97	2,555,000	81	2,946,900	102	2,172,700	105

TABLE No. 23. — *Average Daily Consumption of Water in Cities and Towns, etc. — Continued.*

City or town.	Population supplied.	MONTH.	MELOSE.		REVERE.		WATERTOWN.		ARLINGTON.		MILTON.		WINTHROP.	
			11,870.		11,020. <sup>1</sup>		11,930.		10,220.		7,320.		7,580.	
			GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.		GALLONS.	
			Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January, .	.	.	1,671,800	113	1,304,100	95	678,400	58	824,900	82	311,900	43	853,600	115
February, .	.	.	1,845,100	125	1,530,600	111	716,200	61	970,500	96	291,000	40	959,800	129
March, .	.	.	1,726,400	117	1,243,000	90	692,000	59	780,900	77	269,800	37	843,200	113
April, .	.	.	1,623,900	110	1,152,100	83	742,000	63	775,800	76	300,100	41	797,400	106
May, .	.	.	1,652,800	111	1,141,400	82	815,000	69	821,900	81	368,000	51	787,100	105
June, .	.	.	1,794,000	121	1,307,200	94	866,600	73	1,007,700	99	408,500	56	951,700	126
July, .	.	.	1,817,500	122	1,437,700	103	956,600	80	1,275,000	125	420,900	57	1,127,100	149
August, .	.	.	1,954,200	131	1,504,500	107	956,900	80	1,520,000	149	448,200	61	1,162,100	153
September, .	.	.	1,743,700	117	1,268,500	90	872,900	73	1,004,000	98	353,000	48	904,600	119
October, .	.	.	1,726,800	116	1,055,500	75	860,500	72	861,300	84	313,000	42	794,800	104
November, .	.	.	1,692,800	113	997,300	70	737,400	61	724,100	70	298,500	40	731,200	95
December, .	.	.	1,732,600	116	973,700	68	660,800	55	718,800	70	292,700	39	697,400	91
For the year, .	.	.	17,418,000	118	12,410,700	88	796,800	67	939,800	92	339,800	46	883,400	117

<sup>1</sup> Includes 270 people in Saugus.

TABLE No. 23. — *Average Daily Consumption of Water in Cities and Towns, etc. — Concluded.*

City or town, . . . . .	STONEHAM.			BELMONT.			LEXINGTON.			NAHANT.			SWAMPSCOTT.			METROPOLITAN DISTRICT.		
	6,510.			4,560.			4,420.			1,850.			6,420.			934,730.		
	GALLONS.			GALLONS.			GALLONS.			GALLONS.			GALLONS.			GALLONS.		
Month.	Per Day.	Per Capita.		Per Day.	Per Capita.		Per Day.	Per Capita.		Per Day.	Per Capita.		Per Day.	Per Capita.		Per Day.	Per Capita.	
January, . . . . .	483,000	75	.	237,500	53	.	292,500	68	.	80,800	87	.	348,700	64	.	134,725,400	146	.
February, . . . . .	576,100	89	.	260,400	58	.	313,500	72	.	87,100	94	.	383,200	70	.	146,118,200	158	.
March, . . . . .	581,600	90	.	262,200	58	.	317,600	73	.	72,100	78	.	358,800	66	.	128,891,700	139	.
April, . . . . .	542,800	84	.	260,500	57	.	307,300	70	.	83,300	90	.	361,700	66	.	118,269,200	128	.
May, . . . . .	537,200	83	.	318,300	70	.	318,200	72	.	119,400	62	.	423,200	65	.	118,247,400	127	.
June, . . . . .	571,200	88	.	427,100	94	.	359,900	82	.	173,500	59	.	566,900	76	.	121,202,600	130	.
July, . . . . .	633,600	97	.	493,600	108	.	375,600	85	.	272,200	79	.	770,200	96	.	124,211,800	133	.
August, . . . . .	712,300	109	.	571,900	125	.	467,100	105	.	300,300	87	.	894,300	112	.	126,575,200	135	.
September, . . . . .	665,100	102	.	353,400	77	.	339,500	76	.	174,600	60	.	543,200	72	.	120,233,700	128	.
October, . . . . .	656,500	100	.	264,600	58	.	290,400	65	.	96,900	50	.	396,600	61	.	119,337,900	127	.
November, . . . . .	652,300	100	.	253,700	56	.	278,000	62	.	84,400	91	.	321,600	58	.	115,385,700	123	.
December, . . . . .	668,300	102	.	261,300	57	.	229,900	51	.	78,500	84	.	334,000	60	.	118,142,900	126	.
For the year, . . . . .	606,900	93	.	331,100	73	.	324,000	73	.	135,400	73	.	475,300	74	.	124,135,100	133	.

TABLE No. 24. — (Pump Basis.) Consumption of Water in the Metropolitan Water District, as constituted in the Year 1907, the Town of Swampscott and a Small Section of the Town of Saugus, from 1893 to 1907.

[Gallons per day.]

MONTH.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
January, . . .	75,209,000	67,506,000	68,925,000	82,946,000	85,366,000	83,880,000	96,442,000	100,055,000
February, . . .	71,900,000	68,944,000	80,375,000	87,021,000	83,967,000	87,475,000	103,454,000	98,945,000
March, . . .	67,638,000	62,710,000	69,543,000	86,111,000	82,751,000	85,468,000	90,200,000	97,753,000
April, . . .	62,309,000	57,715,000	62,909,000	77,529,000	79,914,000	76,574,000	86,491,000	89,497,000
May, . . .	61,025,000	60,676,000	65,194,000	73,402,000	76,772,000	76,677,000	89,448,000	87,780,000
June, . . .	63,374,000	68,329,000	69,905,000	77,639,000	77,952,000	83,463,000	97,691,000	98,581,000
July, . . .	69,343,000	73,642,000	69,667,000	80,000,000	85,525,000	88,228,000	96,821,000	107,786,000
August, . . .	66,983,000	67,995,000	72,233,000	78,537,000	84,103,000	87,558,000	92,072,000	102,717,000
September, . .	64,654,000	67,137,000	73,724,000	74,160,000	84,296,000	88,296,000	91,478,000	103,612,000
October, . . .	63,770,000	62,735,000	67,028,000	71,762,000	79,551,000	81,770,000	89,580,000	98,358,000
November, . . .	61,204,000	62,231,000	64,881,000	71,933,000	72,762,000	78,177,000	86,719,000	93,648,000
December, . . .	66,700,000	65,108,000	70,443,000	79,449,000	76,594,000	86,355,000	85,840,000	97,844,000
Average, . . .	66,165,000	65,382,000	69,499,000	78,360,000	80,793,000	83,651,000	92,111,000	98,050,000
Population, . .	723,153	743,354	763,557	786,385	809,213	832,042	854,870	877,698
Per capita, . . .	91.5	88.0	91.0	99.7	99.8	100.5	107.8	111.7

MONTH.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
January, . . .	111,275,000	118,435,000	125,176,000	137,771,000	130,878,000	126,093,000	137,730,000
February, . . .	117,497,000	117,268,000	122,728,000	143,222,000	140,595,000	130,766,000	150,822,000
March, . . .	105,509,000	108,461,000	111,977,000	123,334,000	120,879,000	123,670,000	134,202,000
April, . . .	93,317,000	103,153,000	107,179,000	108,688,000	111,898,000	118,428,000	121,556,000
May, . . .	95,567,000	106,692,000	111,589,000	111,715,000	115,804,000	122,404,000	123,502,000
June, . . .	103,420,000	110,002,000	105,590,000	111,209,000	117,441,000	121,882,000	125,623,000
July, . . .	106,905,000	108,340,000	107,562,000	113,584,000	124,769,000	118,726,000	128,779,000
August, . . .	102,815,000	107,045,000	103,570,000	112,836,000	121,158,000	120,591,000	131,098,000
September, . .	102,103,000	107,752,000	106,772,000	114,188,000	120,103,000	121,685,000	124,751,000
October, . . .	103,389,000	106,560,000	103,602,000	108,290,000	118,301,000	116,561,000	124,051,000
November, . . .	101,324,000	105,175,000	103,477,000	108,054,000	116,693,000	113,746,000	119,627,000
December, . . .	113,268,000	125,434,000	114,721,000	125,119,000	122,696,000	130,995,000	122,407,000
Average, . . .	104,645,000	110,345,000	110,277,000	118,114,000	121,671,000	122,085,000	128,561,000
Population, . .	892,740	907,780	922,820	937,860	953,556	965,990	986,680
Per capita, . . .	117.2	121.6	119.5	125.9	127.6	126.4	130.3

This table includes the water consumed in the cities and towns enumerated in Table No. 19, together with the water consumed in Newton and Hyde Park, which are included in the Metropolitan Water District, but have not been supplied from the Metropolitan Works. The populations for the years 1901 to 1904 were revised after the census of 1905 became available, and consequently the figures in the reports after 1904 differ from those published in a corresponding table in the preceding annual reports.



TABLE No. 25. — *Chemical Examinations of Water from the Wachusett Reservoir, Clinton.*  
[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORA- TION.		AMMONIA.				NITROGEN AS		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	COLOR.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID.			Nitrates.	Nitrites.		
										Total.	Dissolved.	Suspended.				
1907.	Jan. 16	V. slight.	Slight, also scum.	22	Faintly vegetable and cucumber.	Distinctly vegetable and cucumber.	3.10	1.00	.0034	.0154	.0120	.0034	.0020	.0002	.28	0.8
	Feb. 6	None.	V. slight.	20	Faintly vegetable and unpleasant.	Distinctly vegetable and unpleasant.	3.30	1.40	.0032	.0120	.0098	.0022	.0030	.0000	.35	0.8
	March 5	V. slight.	Slight.	27	Distinctly vegetable and cucumber.	Decidedly vegetable and cucumber.	3.25	1.15	.0036	.0194	.0146	.0048	.0030	.0002	.42	0.8
	March 19	V. slight.	V. slight.	23	V. faintly vegetable. synura.	Faintly vegetable. synura.	3.70	1.05	.0028	.0118	.0110	.0008	.0040	.0001	.37	0.8
55362	April 2	V. slight.	V. slight.	19	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.15	1.00	.0014	.0112	.0096	.0016	.0030	.0000	.32	0.8
55515	April 16	Slight.	V. slight.	21	V. faintly vegetable.	Faintly vegetable.	3.20	1.00	.0018	.0138	.0110	.0028	.0050	.0001	.35	0.8
55654	May 7	V. slight.	V. slight.	20	Faintly vegetable.	Faintly vegetable.	2.55	1.10	.0010	.0112	.0098	.0014	.0050	.0002	.28	0.6
55909	May 21	V. slight.	Slight.	17	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.35	1.20	.0014	.0132	.0100	.0032	.0030	.0002	.31	0.6
56097	June 3	V. slight.	V. slight.	19	V. faintly unpleasant.	Faintly unpleasant.	3.20	1.35	.0022	.0082	.0078	.0004	.0030	.0001	.29	0.5
56293	June 18	V. slight.	V. slight.	22	Faintly vegetable.	Distinctly vegetable.	3.40	1.45	.0030	.0106	.0094	.0012	.0030	.0002	.28	0.6
56450	July 2	V. slight.	Slight, also scum.	19	Faintly vegetable and sweetish.	Distinctly vegetable and sweetish.	2.45	1.15	.0012	.0162	.0092	.0070	.0010	.0001	.29	0.5

66965	July 23	V. slight.	V. slight.	15	Faintly vegetable and unpleasant.	2.45	1.30	.0020	.0154	.0090	.0064	.26	.0010	.0000	.29	1.1
67256	Aug. 6	Slight.	Slight.	17	Distinctly vegetable and unpleasant.	4.10	1.50	.0030	.0206	.0146	.0060	.31	.0010	.0002	.33	0.6
67521	Aug. 20	V. slight.	Slight.	15	V. faintly vegetable.	2.50	1.25	.0008	.0116	.0084	.0032	.27	.0010	.0000	.24	0.8
67795	Sept. 4	V. slight.	V. slight.	11	Faintly vegetable.	2.90	1.35	.0028	.0114	.0100	.0014	.29	.0000	.0000	.25	0.6
67940	Sept. 17	V. slight.	V. slight.	13	Faintly unpleasant.	3.10	1.15	.0008	.0154	.0114	.0040	.25	.0010	.0000	.23	0.6
68242	Oct. 1	V. slight.	Slight.	12	V. faintly unpleasant.	2.70	0.55	.0012	.0114	.0088	.0026	.26	.0010	.0001	.27	0.6
68481	Oct. 15	V. slight.	V. slight.	11	V. faintly unpleasant.	2.90	1.20	.0014	.0094	.0082	.0012	.28	.0030	.0000	.23	0.6
68786	Nov. 5	V. slight.	V. slight.	15	Faintly unpleasant.	3.55	1.05	.0020	.0096	.0084	.0012	.26	.0020	.0002	.36	0.6
69082	Nov. 19	V. slight.	V. slight.	15	Faintly unpleasant and fishy.	3.45	1.35	.0012	.0102	.0092	.0010	.30	.0040	.0001	.26	1.0
69350	Dec. 3	V. slight.	V. slight.	17	V. faintly vegetable.	2.65	1.05	.0014	.0088	.0078	.0010	.23	.0020	.0002	.27	0.6
69578	Dec. 17	V. slight.	Slight.	18	Faintly unpleasant.	3.25	1.85	.0012	.0096	.0084	.0012	.21	.0020	.0001	.33	0.6
Av.	.....	.....	.....	18	.....	3.10	1.20	.0019	.0126	.0099	.0026	.25	.0025	.0001	.30	0.7

TABLE No. 26. — *Chemical Examinations of Water from Sudbury Reservoir.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.		ODOR.		RESIDUE ON EVAPORA- TION.		AMMONIA.				NITROGEN AS		Oxygen Consumed.	Hardness.		
		Turbidity.	Sediment.	COLOR.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID.		Nitrates.	Nitrites.				
										Total.	Dissolved.					Suspended.	
1907.																	
64467	Jan. 15	Slight.	V. slight.	28	Faintly vegetable and unpleasant.	Distinctly vegetable and unpleasant.	3.85	1.20	.0050	.0184	.0146	.0038	.25	.0070	.0002	.34	0.6
64753	Feb. 4	V. slight.	V. slight.	27	Faintly unpleasant, cucumber odor.	Distinctly unpleasant, cucumber odor.	3.80	1.60	.0048	.0136	.0128	.0008	.28	.0110	.0001	.37	1.1
65196	March 4	V. slight.	V. slight.	25	Faintly cucumber, synura.	Distinctly cucumber, synura.	3.35	1.05	.0082	.0138	.0110	.0028	.25	.0090	.0001	.39	1.1
65485	April 1	V. slight.	Slight.	20	V. faintly vegetable.	Faintly vegetable.	3.55	1.25	.0028	.0128	.0116	.0012	.25	.0050	.0001	.30	1.0
65888	May 6	V. slight.	Slight.	27	Faintly vegetable.	Distinctly vegetable.	3.65	1.55	.0016	.0142	.0118	.0024	.30	.0070	.0001	.35	1.1
66267	June 3	V. slight.	Slight.	18	Faintly vegetable.	Faintly vegetable.	3.05	1.00	.0044	.0118	.0090	.0028	.27	.0050	.0002	.31	1.3
66648	July 2	V. slight.	Cons.	19	Faintly vegetable.	Distinctly vegetable.	3.60	1.40	.0014	.0146	.0118	.0028	.25	.0020	.0001	.30	1.0
67223	Aug. 5	None.	V. slight.	13	Faintly unpleasant.	Distinctly unpleasant.	4.10	2.05	.0016	.0110	.0100	.0010	.30	.0010	.0001	.23	0.8
67532	Sept. 3	V. slight.	Slight.	10	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	3.45	1.05	.0032	.0114	.0098	.0016	.26	.0010	.0000	.25	0.8
68223	Oct. 1	V. slight.	V. slight.	11	V. faintly unpleasant.	Faintly unpleasant.	2.55	0.60	.0026	.0100	.0086	.0014	.31	.0010	.0000	.21	0.8
68756	Nov. 4	None.	V. slight.	15	Faintly unpleasant.	Distinctly unpleasant, fishy.	3.15	1.10	.0020	.0134	.0106	.0028	.29	.0030	.0002	.28	1.3
69363	Dec. 4	V. slight.	Slight.	21	V. faintly unpleasant.	Faintly unpleasant.	3.45	1.65	.0024	.0126	.0114	.0012	.24	.0030	.0001	.30	1.3
Av.	.....	.....	.....	20	.....	.....	3.46	1.29	.0033	.0131	.0111	.0021	.27	.0046	.0001	.30	1.0

TABLE No. 27. — *Chemical Examinations of Water from Spot Pond, Stonham.*  
[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORA- TION.		AMMONIA.				NITROGEN AS		Oxygen Consumed.	Hardness.	
		Turbidity.	Sediment.	COLOR.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID.			Nitrates.	Nitrites.			
										Total.	Dissolved.	Suspended.					
	1907.																
34497	Jan. 17	V. slight.	V. slight.	17	V. faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	2.75	1.00	.0042	.0156	.0142	.0014	.34	.0020	.0006	.28	1.3
31779	Feb. 4	V. slight.	V. slight.	15	Faintly unpleasant.	Distinctly unpleasant.	4.35	1.60	.0038	.0136	.0126	.0010	.36	.0040	.0000	.30	1.4
35173	March 4	V. slight.	V. slight.	16	V. faintly vegetable.	Faintly vegetable.	3.25	1.15	.0038	.0112	.0102	.0010	.26	.0050	.0004	.34	1.4
35483	April 1	V. slight.	Slight.	15	Faintly vegetable.	Faintly vegetable.	3.10	1.10	.0026	.0124	.0110	.0014	.28	.0050	.0000	.23	1.3
35877	May 6	V. slight.	Slight.	12	Faintly unpleasant, fishy.	Distinctly unpleasant, fishy.	3.40	1.25	.0004	.0130	.0110	.0020	.29	.0040	.0001	.25	1.1
36243	June 3	V. slight.	Slight.	13	V. faintly vegetable.	Faintly vegetable.	3.10	1.40	.0022	.0120	.0038	.0022	.28	.0020	.0001	.24	1.0
36617	July 1	V. slight.	V. slight.	11	Faintly vegetable.	Faintly vegetable.	2.85	1.15	.0002	.0140	.0122	.0018	.28	.0010	.0001	.26	1.3
37219	Aug. 5	V. slight.	Slight, iron.	11	Faintly vegetable.	Faintly vegetable.	3.35	1.25	.0004	.0152	.0124	.0028	.32	.0010	.0000	.25	1.0
37741	Sept. 3	V. slight.	Slight.	10	Distinctly vegetable.	Distinctly vegetable.	2.95	1.00	.0014	.0160	.0126	.0034	.34	.0010	.0001	.24	1.3
38303	Oct. 7	V. slight.	Slight.	13	V. faintly vegetable.	Faintly vegetable.	2.85	1.00	.0020	.0154	.0132	.0022	.38	.0020	.0000	.22	1.4
38867	Nov. 11	V. slight.	V. slight.	12	None.	Faintly vegetable.	3.45	1.00	.0016	.0120	.0100	.0020	.35	.0010	.0000	.25	1.1
39404	Dec. 9	V. slight.	Slight.	13	V. faintly vegetable.	Faintly vegetable.	3.85	1.50	.0012	.0128	.0118	.0010	.36	.0020	.0001	.24	1.6
AV.	.....	.....	.....	13	.....	.....	3.27	1.20	.0020	.0136	.0118	.0019	.32	.0025	.0001	.26	1.3

TABLE No. 28. — *Chemical Examinations of Water from Lake Cochituate.*  
[Paris per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORA- TION.		AMMONIA.				NITROGEN AS		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	COLOR.					Free.	Total.	Dissolved.	Suspended.				
					Cold.	Hot.	Total.	Loss on Ignition.					Nitrates.	Nitrites.		
<b>1907.</b>																
64449	Jan. 15	Slight	Slight.	27	Faintly vegetable, cucumber.	Distinctly vegetable, cucumber.	5.10	1.85	.0038	.0220	.0180	.0040	.0030	.0001	.35	2.1
64777	Feb. 4	V. slight.	V. slight.	32	Distinctly unpleasant and musty. Cucum-ber, synura.	Distinctly unpleasant and musty. Cucum-ber, synura.	5.70	2.25	.0044	.0178	.0156	.0022	.0070	.0001	.50	2.2
65133	March 4	V. slight.	V. slight.	28	V. faintly unpleasant.	Faintly unpleasant.	6.10	2.05	.0016	.0168	.0158	.0010	.0080	.0001	.44	1.8
65496	April 1	V. slight.	V. slight.	27	Distinctly musty, de-caying organisms.	Decidedly musty, de-caying organisms.	5.40	2.05	.0014	.0192	.0170	.0022	.0050	.0001	.41	1.7
65885	May 6	Slight.	Slight.	23	Distinctly unpleasant and musty.	Distinctly unpleasant and musty.	4.80	2.25	.0068	.0196	.0160	.0036	.0040	.0002	.42	1.8
66246	June 3	V. slight.	Cons.	26	Faintly vegetable and musty.	Distinctly vegetable and musty.	4.80	1.95	.0024	.0362	.0194	.0168	.0020	.0002	.39	1.7
66628	July 1	Slight.	Slight.	23	Faintly unpleasant.	Distinctly unpleasant.	4.85	1.25	.0032	.0328	.0228	.0100	.0010	.0001	.45	2.2
67228	Aug. 4	V. slight.	Slight.	21	Faintly unpleasant and vegetable.	Faintly unpleasant and vegetable.	5.00	2.10	.0012	.0196	.0168	.0028	.0010	.0002	.42	2.3
67739	Sept. 3	V. slight.	Slight.	19	Faintly vegetable and unpleasant.	Distinctly vegetable and faintly unpleas-ant.	5.05	1.85	.0024	.0278	.0192	.0086	.0010	.0000	.42	2.1
68216	Oct. 1	V. slight.	Slight.	18	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	4.80	1.70	.0014	.0226	.0168	.0058	.0010	.0000	.36	2.0
68747	Nov. 4	V. slight.	Cons.	21	Faintly vegetable and unpleasant.	Faintly vegetable and unpleasant.	5.95	2.20	.0082	.0224	.0178	.0046	.0010	.0001	.41	2.1
69410	Dec. 9	Slight.	Slight.	26	Faintly vegetable.	Distinctly vegetable.	5.50	1.80	.0012	.0230	.0162	.0068	.0020	.0001	.39	2.1
AV...	.....	.....	.....	24	.....	.....	5.25	1.94	.0032	.0233	.0176	.0057	.0030	.0001	.41	2.0

TABLE No. 29. — *Chemical Examinations of Water from a Tap at the State House, Boston.*  
[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.			ODOR.		RESIDUE ON EVAPORA- TION.		AMMONIA.				NITROGEN AS		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	COLOR.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Nitrates.	Nitrites.		
	1907.															
64442	Jan. 14	V. slight.	Slight.	19	Faintly vegetable.	Faintly vegetable.	3.10	1.15	.0022	.0122	.0110	.0012	.0080	.0001	.29	1.1
64748	Feb. 4	V. slight.	V. slight.	22	Faintly vegetable.	Distinctly vegetable.	4.00	1.50	.0046	.0106	.0090	.0016	.0130	.0001	.33	1.1
65170	March 4	Slight.	None.	23	V. faintly unpleasant.	Faintly unpleasant.	4.00	1.25	.0024	.0108	.0100	.0008	.0140	.0001	.31	1.3
65481	April 1	V. slight.	V. slight.	22	Distinctly vegetable.	Distinctly vegetable.	3.95	1.20	.0010	.0128	.0110	.0018	.0110	.0001	.29	1.3
65875	May 6	V. slight.	Slight.	19	Faintly vegetable.	Faintly vegetable.	3.30	1.40	.0006	.0112	.0086	.0026	.0090	.0001	.32	1.1
66242	June 3	Slight.	V. slight.	26	Faintly vegetable.	Distinctly vegetable.	3.20	1.00	.0008	.0094	.0086	.0008	.0060	.0000	.30	1.4
66618	July 1	V. slight.	Cons.	26	Distinctly vegetable, faintly unpleasant.	Distinctly vegetable, faintly unpleasant.	3.55	1.35	.0008	.0174	.0126	.0048	.0040	.0001	.34	1.0
67209	Aug. 5	V. slight.	V. slight.	22	Faintly vegetable and earthy.	Distinctly vegetable and earthy.	4.15	1.65	.0008	.0146	.0128	.0018	.0030	.0000	.41	1.3
67722	Sept. 3	V. slight.	V. slight.	26	V. faintly unpleasant.	Faintly unpleasant.	4.80	1.45	.0008	.0148	.0124	.0024	.0020	.0001	.35	1.3
68208	Oct. 1	V. slight.	V. slight.	25	V. faintly vegetable.	Faintly vegetable.	4.15	1.40	.0004	.0132	.0108	.0024	.0030	.0001	.35	1.3
68759	Nov. 4	V. slight.	V. slight.	15	Faintly vegetable and sweetish.	Distinctly vegetable and sweetish.	3.65	1.80	.0014	.0140	.0132	.0008	.0030	.0001	.29	1.7
69344	Dec. 3	V. slight.	V. slight.	19	Faintly earthy.	Faintly earthy.	4.15	1.65	.0002	.0132	.0108	.0024	.0060	.0001	.31	1.7
AV.	.....	.....	.....	22	.....	.....	3.83	1.40	.0013	.0129	.0109	.0020	.0068	.0001	.32	1.3



TABLE NO. 30. — *Averages of Examinations of Water from Various Parts of the Metropolitan Water Works in 1907.*  
 [Parts per 100,000.]

LOCALITY.	Samples Collected.	COLOR.	RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
			Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
						Total.	Dissolved.	Suspended.					
Quinepoxet River, Holden, . . .	Semi-monthly,	46	3.78	1.52	.0023	.0172	.0137	.0035	.34	.0050	.0001	.52	0.5
Stillwater River, Sterling, . . .	Semi-monthly,	41	3.28	1.36	.0014	.0135	.0113	.0021	.17	.0021	.0001	.45	0.6
Wachusett Reservoir, West Boylston, . . .	Semi-monthly,	32	3.41	1.30	.0018	.0138	.0117	.0021	.25	.0033	.0001	.40	0.6
Wachusett Reservoir, Clinton, surface, . . .	Semi-monthly,	18	3.10	1.20	.0019	.0126	.0099	.0026	.25	.0025	.0001	.30	0.7
Wachusett Reservoir, Clinton, bottom, . . .	Semi-monthly,	19	3.14	1.18	.0021	.0114	.0094	.0019	.25	.0039	.0001	.30	0.7
Marlborough (Walker's Brook), . . .	Monthly,	68	17.82	5.15	.3181	.0561	.0401	.0159	2.34	.1301	.0046	1.07	6.0
Marlborough Brook filter-beds, effluent, . . .	Monthly,	10	13.89	—	.1007	.0134	—	—	1.74	.2280	.0006	.29	4.7
Wachusett Aqueduct, Southborough, . . .	Monthly,	25	3.47	1.32	.0023	.0131	.0114	.0017	.25	.0048	.0001	.37	1.0
Sudbury Reservoir, surface, . . .	Monthly,	20	3.46	1.29	.0033	.0131	.0111	.0021	.27	.0046	.0001	.30	1.0
Sudbury Reservoir, bottom, . . .	Monthly,	18	3.18	1.35	.0038	.0123	.0103	.0020	.27	.0048	.0001	.30	1.0
Framingham Reservoir, No. 3, inlet, . . .	Monthly,	17	3.59	1.35	.0028	.0117	.0101	.0016	.27	.0063	.0001	.28	1.2
Framingham Reservoir, No. 3, near dam, . . .	Monthly,	18	3.32	1.36	.0027	.0143	.0107	.0036	.28	.0040	.0001	.31	1.2
Hopkinton Reservoir, inlet, . . .	Monthly,	123	5.84	2.83	.0025	.0263	.0233	.0030	.44	.0016	.0001	1.17	1.4
Hopkinton Reservoir, surface, . . .	Monthly,	55	4.00	1.91	.0018	.0170	.0145	.0025	.35	.0026	.0001	.63	1.0
Hopkinton Reservoir, bottom, . . .	Monthly,	56	3.99	1.83	.0026	.0171	.0146	.0024	.35	.0026	.0001	.64	0.9
Asland Reservoir, inlet, . . .	Monthly,	97	4.92	2.40	.0021	.0238	.0214	.0025	.31	.0036	.0001	.94	1.2
Asland Reservoir, surface, . . .	Monthly,	57	3.98	1.77	.0023	.0189	.0157	.0032	.29	.0029	.0001	.62	0.9
Asland Reservoir, bottom, . . .	Monthly,	58	4.07	1.95	.0023	.0181	.0161	.0020	.29	.0031	.0001	.62	0.9
Asland Reservoir, bottom, No. 2, inlet, . . .	Monthly,	73	4.56	2.10	.0020	.0213	.0189	.0024	.33	.0030	.0001	.78	1.0
Framingham Reservoir No. 2, near dam, . . .	Monthly,	65	4.19	1.91	.0019	.0188	.0170	.0017	.32	.0032	.0001	.71	0.9
Lake Cochituate, surface, . . .	Monthly,	24	5.25	1.94	.0032	.0253	.0176	.0037	.32	.0030	.0001	.41	2.0
Lake Cochituate, bottom, . . .	Monthly,	47	5.70	2.00	.0303	.0203	.0158	.0045	.50	.0034	.0003	.57	2.2
Dug Pond, . . .	Monthly,	13	5.01	1.81	.0039	.0246	.0196	.0070	.64	.0028	.0002	.33	1.8
Weston Reservoir, . . .	Monthly,	16	3.60	1.44	.0019	.0118	.0097	.0021	.27	.0059	.0002	.28	1.2
Terminal chamber, Sudbury Aqueduct, . . .	Monthly,	24	3.45	1.41	.0023	.0140	.0117	.0023	.29	.0055	.0001	.33	1.1
Spot Pond, . . .	Monthly,	13	3.27	1.20	.0020	.0136	.0118	.0019	.32	.0025	.0001	.26	1.3
Tap at Revere, . . .	Monthly,	11	3.68	1.43	.0013	.0121	.0105	.0016	.32	.0031	.0001	.26	1.3
Tap at State House, . . .	Monthly,	22	3.83	1.40	.0013	.0129	.0109	.0020	.33	.0068	.0001	.32	1.3
Tap in Quincy, . . .	Monthly,	19	3.71	1.30	.0011	.0115	.0105	.0010	.35	.0075	.0001	.29	1.4

TABLE NO. 31. — *Chemical Examinations of Water from a Faucet in Boston, from 1892 to 1907.*

[Parts per 100,000.]

YEAR.	COLOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
	Nessler Standard.	Platinum Standard.	Total.	Loss on Ignition.	Free.	ALBUMINOID.		Nitrates.		Nitrites.			
						Total.	Dissolved.				Suspended.		
1892, . .	.37	37	4.70	1.67	.0007	.0168	.0138	.0030	.41	.0210	.0001	-	1.9
1893, . .	.61	53	4.54	1.84	.0010	.0174	.0147	.0027	.38	.0143	.0001	.60	1.8
1894, . .	.69	58	4.64	1.83	.0006	.0169	.0150	.0019	.41	.0106	.0001	.63	1.7
1895, . .	.72	59	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.69	0.7
1896, . .	.49	45	4.29	1.67	.0005	.0165	.0142	.0023	.37	.0155	.0001	.56	1.4
1897, . .	.65	55	4.82	1.84	.0009	.0193	.0177	.0016	.40	.0137	.0001	.64	1.6
1898, . .	.41	40	4.19	1.60	.0008	.0152	.0136	.0016	.29	.0097	.0001	.44	1.4
1899, . .	.23	28	3.70	1.30	.0006	.0136	.0122	.0014	.24	.0137	.0001	.35	1.1
1900, . .	.24	29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.0076	.0001	.38	1.3
1901, . .	.24	29	4.43	1.64	.0013	.0158	.0142	.0016	.30	.0173	.0001	.42	1.7
1902, . .	.26	30	3.93	1.56	.0016	.0139	.0119	.0020	.29	.0092	.0000	.40	1.3
1903, . .	.25	29	3.98	1.50	.0013	.0125	.0110	.0015	.30	.0142	.0001	.39	1.5
1904, . .	-	23	3.93	1.59	.0023	.0139	.0121	.0018	.34	.0110	.0001	.37	1.5
1905, . .	-	24	3.86	1.59	.0020	.0145	.0124	.0021	.35	.0083	.0001	.35	1.4
1906, . .	-	24	3.86	1.39	.0018	.0159	.0134	.0025	.34	.0054	.0001	.36	1.3
1907, . .	-	22	3.83	1.40	.0013	.0129	.0109	.0020	.33	.0068	.0001	.32	1.3

*Note relating to Chemical Examinations of Water, Tables Nos. 25-31.*

The chemical examinations contained in the tables were made by the State Board of Health. Previous to the year 1904 colors were determined by the Nessler standard, but the corresponding values by the platinum standard are also given, for the purpose of comparison with colors determined in the laboratory of the Metropolitan Water and Sewerage Board, as given in subsequent tables. The odor recorded is taken in such a way that it is a much stronger odor than would be noticed in samples drawn directly from a tap or collected directly from a reservoir. The important samples are collected and examined semi-monthly or monthly.

TABLE NO. 32. — *Colors of Water from Various Parts of the Metropolitan Water Works in 1907. (Means of Weekly Determinations.)*

[Platinum Standard.]

MONTH.	WACHUSETT RESERVOIR.						SUDBURY RESERVOIR.				FRAMINGHAM RESERVOIR No. 3.	LAKE COCHITUATE.			
	Surface.	Mid-depth.	Bottom.	Worcester Street Bridge.	Quinepoxt River.	Stillwater River.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Mid-depth.	Surface.	Mid-depth.	Bottom.	Influent Streams. <sup>1</sup>
January, . . .	19	19	19	36	44	39	22	21	21	29	20	29	28	29	48
February, . . .	25	23	22	33	40	33	27	25	25	24	24	38	31	65	58
March, . . .	27	25	25	39	45	35	25	25	25	34	25	38	29	70	69
April, . . .	23	23	23	37	42	35	23	23	24	34	24	30	31	32	83
May, . . .	26	24	24	42	58	50	24	24	24	31	25	34	29	29	103
June, . . .	24	24	24	43	58	51	23	23	23	32	24	35	31	47	108
July, . . .	23	22	22	40	59	52	21	21	22	24	23	28	28	66	91
August, . . .	23	23	23	44	38	38	22	22	22	24	22	29	31	55	77
September, . .	19	19	20	22	49	42	18	19	19	24	19	26	30	44	81
October, . . .	15	15	16	33	67	58	15	15	16	59	17	23	26	144	77
November, . .	17	17	17	40	68	61	17	17	18	50	23	27	27	28	83
December, . .	24	25	25	46	49	41	26	26	26	35	29	27	28	28	90
Mean, . . .	22	22	22	37	52	45	22	22	22	33	23	30	29	53	81

<sup>1</sup> The colors given in this column represent the combined colors of the waters of the four principal feeders. The color of each is determined monthly, and due weight is given, in combining the results, to the sizes of the streams.

TABLE NO. 32 — *Concluded.*

[Platinum Standard.]

MONTH.	CHESTNUT HILL RESERVOIR.			SPOT POND.	FELLS RESERVOIR.	NORTHERN SERVICE.		SOUTHERN SERVICE.	
	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 2.	Mid-depth.	Effluent Gate-house.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 244 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January, . . .	20	—	19	16	16	20	16	19	20
February, . . .	24	32	24	16	16	24	16	24	24
March, . . .	25	33	25	18	18	26	18	25	26
April, . . .	23	27	23	17	16	23	17	23	23
May, . . .	26	—	25	17	17	24	17	24	25
June, . . .	34	28	31	17	17	29	17	27	32
July, . . .	33	27	30	18	18	30	18	28	31
August, . . .	33	28	33	20	20	32	20	31	32
September, . .	38	26	32	17	17	32	18	28	32
October, . . .	28	22	27	17	17	23	15	22	26
November, . .	21	29	21	16	16	19	16	18	22
December, . .	28	27	25	16	16	25	16	25	26
Mean, . . .	28	28	26	17	17	26	17	25	27

TABLE NO. 33. — *Temperatures of Water from Various Parts of the Metropolitan Water Works in 1907. (Means of Weekly Determinations.)*

[The temperatures are taken at the same places and times as the samples for microscopical examination; the depth given for each reservoir is the depth from high-water mark.]

[Degrees Fahrenheit.]

MONTH.	WACHUSETT RESERVOIR.			SUDBURY RESERVOIR (DEPTH AT PLACE OF OBSERVATION 54.5 FEET).				FRAMINGHAM RESERVOIR No. 3 (DEPTH AT PLACE OF OBSERVATION 20.5 FEET).			LAKE COCHITUATE (DEPTH AT PLACE OF OBSERVATION 62.0 FEET).		
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.
January, .	33.0	-	-	34.6	35.4	36.3	34.9	36.0	36.0	35.0	36.0	36.7	37.3
February, .	33.2	34.2	35.3	32.3	33.4	34.4	32.5	34.4	35.0	35.7	35.1	36.6	37.7
March, .	34.5	36.2	35.2	33.4	34.0	35.1	35.6	36.7	37.0	37.4	35.6	36.8	38.5
April, .	41.9	40.9	40.5	41.6	41.9	42.1	41.0	44.2	44.0	43.9	41.3	41.6	41.8
May, .	51.7	49.5	48.6	53.9	53.5	52.6	51.3	54.4	54.5	54.2	54.8	52.8	45.6
June, .	64.5	53.3	52.5	64.0	58.8	57.3	56.4	65.9	63.3	60.6	63.3	56.4	48.0
July, .	71.9	55.8	55.3	74.4	68.8	64.2	61.6	75.6	75.0	73.0	76.0	54.9	47.0
August, .	75.0	62.8	57.1	73.4	71.1	67.9	63.6	73.5	73.2	72.8	73.6	53.6	47.6
September, .	65.8	62.5	56.0	68.3	68.0	67.1	63.9	67.8	68.3	68.1	70.0	56.0	47.0
October, .	56.6	56.2	53.8	56.5	56.7	56.4	54.4	53.2	53.7	53.8	56.0	54.3	46.4
November, .	47.0	47.3	47.0	44.9	45.3	45.4	45.6	43.9	43.6	43.7	47.1	46.6	46.4
December, .	38.5	38.6	38.6	36.0	36.5	36.7	37.1	35.9	36.0	36.0	37.7	38.2	38.4
Mean, .	51.1	48.8	47.3	51.1	50.3	49.6	48.2	51.8	51.6	51.2	52.2	47.0	43.5

TABLE NO. 33 — *Concluded.*

[Degrees Fahrenheit.]

MONTH.	CHESTNUT HILL RESERVOIR.	SPOT POND (DEPTH AT PLACE OF OBSERVATION 28.0 FEET).			NORTHERN SERVICE.		SOUTHERN SERVICE.	
	Effluent Gate-house No. 2.	Surface.	Mid-depth.	Bottom.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 244 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January, .	35.7	36.0	36.1	36.7	38.0	37.6	39.1	38.7
February, .	35.7	35.8	36.8	38.5	37.0	37.1	39.8	39.4
March, .	36.5	36.6	37.5	39.0	37.4	37.5	39.9	38.8
April, .	43.7	42.6	42.6	42.7	43.7	44.3	46.7	46.0
May, .	54.3	53.6	53.4	53.0	52.3	53.0	56.0	56.8
June, .	61.1	61.8	60.1	56.9	58.5	59.6	61.8	62.8
July, .	74.1	72.9	72.3	61.3	68.5	68.6	70.0	73.2
August, .	73.2	73.0	72.9	66.0	70.3	72.3	71.1	72.7
September, .	68.9	68.3	68.1	67.4	66.8	68.8	68.5	68.9
October, .	55.1	56.3	55.9	55.9	56.8	56.6	58.1	58.1
November, .	49.2	45.5	45.5	45.5	48.5	47.5	49.1	49.4
December, .	37.1	36.1	36.1	36.0	40.8	39.4	41.3	40.6
Mean, .	52.1	51.5	51.4	49.9	51.6	51.9	53.5	53.8

TABLE NO. 34. — *Temperatures of the Air at Three Stations on the Metropolitan Water Works in 1907.*

[Degrees Fahrenheit.]

MONTH.	CHESTNUT HILL RESERVOIR.			FRAMINGHAM.			CLINTON.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
January, . . . .	57.0	—9.0	26.1	54.0	—17.0	23.2	55.0	—12.0	22.7
February, . . . .	51.0	—10.0	21.6	48.0	—19.0	18.5	46.0	—11.0	15.8
March, . . . .	72.0	7.0	37.5	76.0	4.0	35.7	77.0	—5.0	33.6
April, . . . .	74.0	21.0	44.0	75.0	19.0	41.9	69.0	20.0	41.1
May, . . . .	82.0	32.0	53.7	85.0	29.0	51.4	84.0	28.0	51.3
June, . . . .	94.0	38.0	64.7	94.0	35.0	62.5	90.0	41.0	64.1
July, . . . .	93.0	53.0	72.6	91.0	46.0	69.6	89.0	56.0	71.4
August, . . . .	99.0	45.0	70.0	96.0	40.0	66.8	92.0	44.0	67.5
September, . . . .	89.0	40.0	64.5	87.0	32.0	63.0	83.0	40.0	61.2
October, . . . .	72.0	21.0	49.1	70.0	16.0	45.4	70.0	25.0	46.5
November, . . . .	61.0	21.0	41.7	61.0	15.0	39.0	60.0	18.0	38.0
December, . . . .	62.0	12.0	34.9	61.0	7.0	31.5	62.0	15.0	32.1
Average, . . . .	—	—	48.4	—	—	45.7	—	—	45.4

TABLE No. 35. — Table showing Length of Main Lines of Water Pipes and Connections owned and operated by Metropolitan Water and Sewerage Board, and Number of Valves set in Same, Dec. 31, 1907.

	DIAMETER OF PIPES IN INCHES.													Total.
	60	48	42	36	30	24	20	16	14	12	10	8	6	
Total length owned and operated January 1, 1907 (feet),	9,069	171,163	8,075	46,638	26,922	46,654	57,085	54,394	26	19,353	614	1,633	877	442,503
Gate valves in same, . . . . .	-	42	-	40	28	39	37	62	1	70	13	14	15	361
Air valves in same, . . . . .	5	102	3	35	-	19	34	29	-	9	-	-	-	240
Length laid or relaid during 1907 (feet), . . . . .	-	-	-	-	-	-	175	171	-	84	-	-	-	430
Gate valves in same, . . . . .	-	-	-	1	-	-	-	-	-	4	-	1	-	6
Air valves in same, . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Length abandoned during 1907 (feet), . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gate valves in same, . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Air valves in same, . . . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Length owned and operated January 1, 1908 (feet), . . . . .	9,069	171,163	8,075	46,638	26,922	46,654	57,200	54,565	26	19,437	614	1,633	877	442,933
Gate valves in same, . . . . .	-	42	-	41	28	39	37	62	1	74	13	15	15	367
Air valves in same, . . . . .	5	102	3	35	4	19	34	29	-	9	-	-	-	240

1 83.89 miles.



TABLE No. 36. — *Statement of Cast-iron Hydrant, Blow-off and Drain Pipes, owned and operated by Metropolitan Water and Sewerage Board, Dec. 31, 1907.*

	DIAMETER OF PIPES IN INCHES.								Total.
	24	20	16	12	10	8	6	4	
Total length in use December 31, 1907 (feet), . . .	352	293	2,250	4,421	173	315	2,713	1,167	11,684
Total valves in use December 31, 1907, . . .	-	-	18	75	1	1	56	38	189

TABLE No. 37. — Length of Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1907.

BY WHOM OWNED.	INCHES.																		TOTAL.		
	60	48	42	40	36	30	28	24	20	18	16	14	12	10	8	7	6	5	4	Feet.	Miles.
Metropolitan Water Works.	9,069	171,163	8,075	-	46,638	26,922	-	46,654	57,260	-	54,565	26	19,437	614	1,633	-	877	-	-	442,933	83.89
Boston, . . .	-	38,263	16,813	23,104	43,488	89,700	244	77,563	94,674	-	205,057	-	73,726	48,286	614,439	-	1,291,615	-	67,702	3,935,286	745.32
Somerville, . .	-	-	-	-	-	-	-	-	3,586	387	3,537	8,037	-	-	95,434	-	138,649	-	20,456	458,108	86.76
Malden, . . .	-	-	-	-	-	-	-	-	-	-	-	9,152	64,216	27,024	73,633	-	203,639	-	63,861	440,925	83.51
Chelsea, . . .	-	-	-	-	-	-	-	-	-	-	2,389	-	-	-	39,511	-	133,083	-	8,448	210,746	39.92
Everett, . . .	-	-	-	-	-	-	-	-	-	-	2,233	206	5,570	39,946	19,847	-	133,548	-	30,972	237,706	45.02
Quincy, . . .	-	-	-	-	-	-	-	-	2,900	-	2,232	-	26,104	32,166	90,344	994	227,284	948	99,854	503,606	95.38
Medford, . . .	-	-	-	-	-	-	-	-	2,679	-	6,775	9,598	26,112	35,738	72,453	-	95,550	-	36,790	283,689	53.73
Melrose, . . .	-	-	-	-	-	-	-	-	673	-	5,223	2,920	24,809	14,616	24,239	-	116,904	-	56,797	245,508	46.50
Revere, <sup>1</sup> . . .	-	-	-	-	-	-	-	-	-	-	22,650	5,700	11,000	17,050	17,355	-	54,382	-	71,284	199,421	37.77
Watertown, . .	-	-	-	-	-	-	-	-	-	-	400	11,877	5,359	4,169	19,511	-	115,879	-	12,666	170,461	32.28
Arlington, . . .	-	-	-	-	-	-	-	-	-	-	-	-	31,804	21,621	28,533	-	81,228	-	28,116	191,302	36.23
Milton, . . .	-	-	-	-	-	-	-	-	-	-	103	44	22,437	19,047	41,491	-	110,270	-	15,326	208,718	39.53
Winthrop, . . .	-	-	-	-	-	-	-	-	-	-	-	-	4,019	4,460	19,329	-	27,828	-	77,731	133,867	25.35
Stonham, . . .	-	-	-	-	-	-	-	-	-	-	-	-	4,525	4,725	2,975	-	90,850	-	13,438	116,513	22.07
Belmont, . . .	-	-	-	-	-	-	-	-	-	-	-	-	2,161	12,302	13,696	-	78,610	-	283	107,052	20.28
Lexington, . . .	-	-	-	-	-	-	-	-	-	-	-	-	9,000	2,664	8,113	-	49,055	-	33,874	102,706	19.45
Nahant, . . .	-	-	-	-	-	-	-	-	-	-	-	-	150	11,550	4,800	-	32,740	-	37,035	86,235	16.34
Swampscott, . .	-	-	-	-	-	-	-	-	-	-	-	-	12,072	16,205	10,636	-	51,973	-	9,110	100,056	18.95
Total feet, . .	9,069	203,426	24,888	23,104	90,126	116,622	244	126,701	161,782	387	326,155	47,560	1,558,733	515,126	1,185,215	994	3,093,964	948	683,763	8,174,897	-
Total miles, . .	1.72	39.66	4.71	4.38	17.07	22.09	0.05	24.00	30.64	0.07	61.77	9.01	235.22	37.56	224.48	0.19	585.98	0.18	129.50	-	1,548.28

<sup>1</sup> Including small portion of Saugus.

TABLE NO. 38. — *Number of Service Pipes, Meters and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1907.*

CITY OR TOWN.	Services.	Meters.	Fire Hydrants.
Boston, . . . . .	93,942	5,190	8,136
Somerville, . . . . .	11,662	3,446	1,022
Malden, . . . . .	7,055	6,780	414
Chelsea, . . . . .	6,603	1,792	326
Everett, . . . . .	5,161	116	517
Quincy, . . . . .	6,091	1,480	715
Medford, . . . . .	4,378	582	513
Melrose, . . . . .	3,429	1,058	297
Revere, <sup>1</sup> . . . . .	2,927	163	152
Watertown, . . . . .	1,886	1,886	335
Arlington, . . . . .	1,929	835	376
Milton, . . . . .	1,285	1,285	317
Winthrop, . . . . .	2,074	70	121
Stoneham, . . . . .	1,331	30	112
Belmont, . . . . .	792	792	164
Lexington, . . . . .	730	80	107
Nahant, . . . . .	410	90	73
Swampscott, . . . . .	1,307	892	131
Total, . . . . .	152,992	26,567	13,828

<sup>1</sup> Includes small portion of Saugus.

TABLE No. 39. — *Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, to which Water rose, at Different Stations on the Metropolitan Water Works in 1907.*

1907. MONTH.	LOW-SERVICE.										SOUTHERN HIGH-SERVICE.							
	BOSTON ENGINE HOUSE, BOLFINCH STREET.		ALLSTON ENGINE HOUSE, HARVARD STREET.		MEDFORD, MYSTIC RESERVOIR.		MEDFORD, WATER WORKS OFFICE, HIGH STREET.		SOMERVILLE CITY HALL ANNEX, WALNUT STREET.		MALDEN WATER WORKS SHOP, GREEN STREET.		CHELSEA WATER WORKS OFFICE, PARK STREET.		BOSTON METRO- POLITAN WATER WORKS OFFICE, 1 ASHBURTON PLACE.		WATERTOWN WATER WORKS OFFICE, MAIN STREET.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
January, .	131	122	187	177	168	165	167	164	164	159	164	161	155	144	245	234	264	261
February, .	125	116	185	175	166	163	165	161	161	155	162	158	147	136	245	234	264	261
March, .	131	122	187	179	166	164	165	162	163	158	163	160	156	145	248	235	263	258
April, .	131	120	187	174	168	164	167	162	169	162	164	160	164	154	249	236	263	259
May, .	135	122	186	173	169	164	168	163	170	163	165	161	165	154	249	235	262	257
June, .	132	118	185	174	169	165	167	164	169	163	165	161	166	153	248	234	261	252
July, .	131	118	185	174	170	165	167	164	170	163	165	162	166	156	247	233	261	251
August, .	130	113	186	175	168	165	167	163	169	162	165	161	165	152	247	233	262	251
September, .	131	118	182	172	168	164	166	164	169	163	164	160	164	153	247	234	262	256
October, .	133	123	183	171	168	163	167	164	169	163	161	157	164	153	249	235	262	258
November, .	133	126	178	171	167	163	167	164	168	163	164	161	164	155	249	235	263	257
December, .	132	120	181	173	167	164	167	165	168	163	162	159	162	153	248	235	262	257
Averages,	131	120	184	174	168	164	167	163	167	161	164	160	162	151	248	234	262	257

TABLE No. 39. — *Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, etc. — Concluded.*

1907. Month.	SOUTHERN HIGH-SERVICE — Concluded.						NORTHERN HIGH-SERVICE.						NORTHERN EXTRA HIGH-SERVICE.					
	BELMONT TOWN HALL, PLEASANT STREET.		MILTON WATER WORKS OFFICE, ADAMS STREET.		QUINCY WATER WORKS SHOP.		SOMERVILLE PUMPING STA- TION, CEDAR STREET.		MALDEN CITY HALL.		REVERE WATER WORKS OFFICE, BROADWAY.		LYNN ENGINE HOUSE, UNION SQUARE.		WINTHROP WATER WORKS OFFICE, WIN- THROP AVENUE.		LEXINGTON TOWN HALL, MASSA- CHUSETTS AVENUE.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	
January, .	259	254	245	236	237	220	268	255	266	269	262	250	259	248	-	-	379	367
February, .	259	253	243	235	234	218	266	253	266	269	254	243	252	241	-	-	378	364
March, .	260	250	246	236	236	219	267	254	267	270	261	250	260	249	-	-	382	368
April, .	260	249	246	236	238	220	268	255	267	270	263	249	261	248	-	-	385	367
May, .	261	246	246	235	239	218	268	254	269	269	263	246	261	245	-	-	386	366
June, .	259	241	247	235	237	214	267	249	269	269	262	230	259	232	195	154	386	362
July, .	258	237	247	234	236	209	267	247	268	268	255	214	250	201	195	146	385	360
August, .	258	228	245	233	235	206	267	247	268	268	257	220	254	208	184	137	386	353
September, .	260	250	244	234	236	214	267	251	269	269	259	236	257	231	183	152	385	364
October, .	261	253	245	235	237	216	268	255	271	265	261	250	260	246	184	161	386	367
November, .	256	251	247	237	239	222	269	257	271	266	264	252	262	251	189	161	398	383
December, .	257	250	247	237	239	223	269	257	272	267	265	253	262	253	194	162	378	366
Averages, .	259 1/2	247	246	235	237	217	268	253	270	265	261	241	258	238	189	153	385	366

## APPENDIX NO. 3.

## WATER WORKS STATISTICS FOR THE YEAR 1907.

The Metropolitan Water Works supply the Metropolitan Water District, which includes the following cities and towns:—

CITY OR TOWN.	Population, Census of 1905.	Estimated Population July 1, 1907.
Boston, . . . . .	595,380	612,580
Somerville, . . . . .	69,272	72,540
Malden, . . . . .	38,037	39,820
Chelsea, . . . . .	37,289	38,650
Newton, <sup>1</sup> . . . . .	36,827	38,310
Everett, . . . . .	29,111	31,350
Quincy, . . . . .	28,076	29,390
Medford, . . . . .	19,686	20,700
Hyde Park, <sup>1</sup> . . . . .	14,510	14,970
Melrose, . . . . .	14,295	14,870
Revere, . . . . .	12,659	13,750
Watertown, . . . . .	11,258	11,930
Arlington, . . . . .	9,668	10,220
Milton, . . . . .	7,054	7,320
Winthrop, . . . . .	7,034	7,580
Stoneham, . . . . .	6,332	6,510
Lexington, . . . . .	4,530	4,920
Belmont, . . . . .	4,360	4,560
Nahant, . . . . .	922	930
Total population of Metropolitan Water District, . .	946,300	980,900
Swampscott, <sup>2</sup> . . . . .	5,141	5,510
Saugus, <sup>3</sup> . . . . .	200	270

<sup>1</sup> No water supplied to these places during the year from Metropolitan Water Works.

<sup>2</sup> Not in the Metropolitan Water District, but has been supplied with water from the Metropolitan Water Works.

<sup>3</sup> Only a small portion of Saugus is supplied with water.



*Mode of Supply.*

25 per cent. by gravity.

75 per cent. by pumping.

*Pumping.**Chestnut Hill High-service Station:—*

Builders of pumping machinery, Holly Manufacturing Company, Quintard Iron Works and E. P. Allis Company.

Description of coal used:— Bituminous: Somerset, Orenda, Barnet, Vulcan Steam and Carbon. Anthracite: buckwheat. Price per gross ton in bins: bituminous \$4.09 to \$4.14, buckwheat \$2.97. Average price per gross ton \$3.75. Per cent. ashes, 13.5.

*Chestnut Hill Low-service Station:—*

Builders of pumping machinery, Holly Manufacturing Company.

Description of coal used:— Bituminous: Somerset, Barnet, Orenda and Carbon. Anthracite: buckwheat. Price per gross ton in bins: bituminous \$3.94 to \$4, buckwheat \$2.87. Average price per gross ton \$3.75. Per cent. ashes, 14.0.

*Spot Pond Station:—*

Builders of pumping machinery, Geo. F. Blake Manufacturing Company and Holly Manufacturing Company.

Description of coal used:— Bituminous: Georges Creek Cumberland. Anthracite: screenings. Price per gross ton in bins: bituminous \$4.35 and \$5, screenings \$2.24. Average price per gross ton \$4.02. Per cent. ashes, 13.0.

	CHESTNUT HILL HIGH-SERVICE STATION.		
	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.
Daily pumping capacity (gallons), . . . . .	16,000,000	20,000,000	30,000,000
Coal consumed for year (pounds), . . . . .	3,639,708	208,364	8,961,000
Cost of pumping, figured on pumping station expenses, . .	\$13,702.08	\$1,885.23	\$32,423.12
Total pumpage for year, corrected for slip (million gallons), .	2,235.69	209.93	10,852.97
Average dynamic head (feet), . . . . .	121.65	129.16	131.79
Gallons pumped per pound of coal, . . . . .	614.25	1,007.52	1,211.13
Duty on basis of plunger displacement, . . . . .	64,180,000	117,130,000	137,050,000
Cost per million gallons raised to reservoir, . . . . .	\$6.129	\$8.980	\$2.987
Cost per million gallons raised one foot, . . . . .	0.050	0.070	0.023

	CHESTNUT HILL LOW-SERVICE STATION.	SPOT POND STATION.
	Engines Nos. 5, 6 and 7.	Engines Nos. 8 and 9.
Daily pumping capacity (gallons), . . . . .	105,000,000	30,000,000
Coal consumed for year (pounds), . . . . .	9,037,261	2,816,358
Cost of pumping, figured on pumping station expenses, . .	\$35,378.97	\$14,249.00
Total pumpage for year, corrected for slip (million gallons), .	21,198.08	3,267.82
Average dynamic head (feet), . . . . .	54.70	129.76
Gallons pumped per pound of coal, . . . . .	2,340.45	2,106.28
Duty on basis of plunger displacement, . . . . .	109,890,000	129,350,000
Cost per million gallons raised to reservoir, . . . . .	\$1.669	\$4.360
Cost per million gallons raised one foot, . . . . .	0.031	0.034

*Consumption.*

Estimated total population of the nineteen cities and towns supplied wholly or partially during the year 1907, . . . . .	934,730
Total consumption (gallons), pump basis, . . . . .	45,650,960,000
Average daily consumption (gallons), pump basis, . . . . .	125,071,000
Gallons per day to each inhabitant, pump basis, . . . . .	133.8

*Distribution.*

	Owned and operated by Metropolitan Water and Sewerage Board.	Total in District supplied by Metropolitan Water Works.
Kinds of pipe used, . . . . .	- 1	- 2
Sizes, . . . . .	60 to 6 inch.	60 to 4 inch.
Extensions, less length abandoned (miles), . . . . .	.09	13.17
Length in use (miles), . . . . .	83.89	1,548.28
Stop gates added, . . . . .	6	-
Stop gates now in use, . . . . .	367	-
Service pipes added, . . . . .	-	1,934
Service pipes now in use, . . . . .	-	152,992
Meters added, . . . . .	-	4,334
Meters now in use, . . . . .	-	26,567
Fire hydrants added, . . . . .	-	137
Fire hydrants now in use, . . . . .	-	13,827

<sup>1</sup> Cast-iron and cement-lined wrought iron.<sup>2</sup> Cast-iron, cement-lined wrought iron and kalamine.

## APPENDIX No. 4.

## CONTRACTS MADE AND PENDING DURING

*Contracts relating to the*

1.	Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID.		6. Contractor.
				4. Next to Lowest.	5. Lowest.	
1	51 <sup>1</sup>	Section 64, Malden Extension, 42-inch and 54-inch diameter, and 28-inch by 42-inch concrete sewer in trench.	4	\$39,388 50	\$33,577 80 <sup>2</sup>	T. H. Gill & Co., Boston.
2	58 <sup>1</sup>	Bulkhead in Chelsea Creek near Chelsea Street Bridge, East Boston.	4	4,218 00	3,330 00 <sup>2</sup>	Lawler Bros., Boston.

*Contracts relating to the*

3	52 <sup>1</sup>	Two horizontal return tubular boilers with masonry settings and connecting smoke flue for the Quincy station.	2	\$4,295 00	\$3,850 00 <sup>2</sup>	Robb-Mumford Boiler Co., Boston.
4	53 <sup>1</sup>	Section 84, Extension of the High-level Sewer, Brookline and Brighton, 69-inch by 72-inch concrete sewer in trench.	14	40,550 00	39,431 00 <sup>2</sup>	D. F. O'Connell, Boston.
5	54 <sup>1</sup>	Part of Section 83, Extension of the High-level Sewer, Brookline, 69-inch by 72-inch concrete sewer in earth tunnel.	8	27,500 00	25,500 00 <sup>2</sup>	Chas. G. Craib & Co., Winthrop, Mass.
6	55 <sup>1</sup>	Part of Section 82, Extension of the High-level Sewer, Brookline, 75-inch by 78-inch brick and concrete sewer in trench.	7	44,430 00 <sup>2</sup>	40,320 00	T. J. O'Connell, Boston.
7	56 <sup>1</sup>	Part of Section 82, Extension of the High-level Sewer, Brookline, 78-inch by 84-inch brick and concrete sewer in trench and tunnel.	6	44,535 00	43,350 00 <sup>2</sup>	Jas. Driscoll & Son, Brookline, Mass.

<sup>1</sup> Contract completed.<sup>2</sup> Contract based upon this bid.

## APPENDIX No. 4.

## THE YEAR 1907. — SEWERAGE WORKS.

*North Metropolitan System.*

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1907.	10. Value of Work done Decem- ber 31, 1907.	
Aug. 8, 1906,	Jan. 5, 1907,	-	\$40,205 25	1
July 16, 1907,	Sept. 4, 1907,	For bulkhead complete and for furnishing all the labor, materials, tools, appliances and other necessary plant, including all incidental work, \$9 per linear foot of bulkhead.	3,231 00	2

*South Metropolitan System.*

Aug. 31, 1906,	Feb. 12, 1907,	-	\$3,850 00	3
Apr. 9, 1907,	Dec. 17, 1907,	For earth excavation and refill for 69-inch by 72-inch sewer in trench, \$5.50 per linear foot; for Portland cement brick masonry, \$16.50 per cubic yard; for Portland cement concrete masonry, \$8.32 per cubic yard; reinforced concrete piles in place, \$0.85 per linear foot; rock excavation in trench, \$5 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	41,096 34	4
Apr. 10, 1907,	Dec. 9, 1907,	For earth excavation and refill for 69-inch by 72-inch sewer in tunnel, \$16 per linear foot; for Portland cement brick masonry in tunnel shafts, \$14 per cubic yard; for Portland cement concrete masonry, \$10 per cubic yard.	\$26,501 00	5
May 29, 1907,	Dec. 30, 1907,	For earth excavation and refill for 75-inch by 78-inch sewer in trench, \$13 per linear foot; for Portland cement brick masonry in trench, \$15 per cubic yard; for Portland cement concrete masonry in trench, \$8.25 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	45,621 66	6
May 21, 1907,	Dec. 18, 1907,	For earth excavation and refill for 78-inch by 84-inch sewer in trench, \$12.50 per linear foot; for earth excavation and refill in tunnel, \$25 per linear foot; for Portland cement brick masonry in trench, \$14 per cubic yard; for Portland cement concrete masonry in trench and tunnel, \$7.50 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	43,242 23	7

## CONTRACTS MADE AND PENDING DURING THE

*Contracts relating to the South*

1. Number of Contract.	2.  WORK.	3. Number of Bids.	AMOUNT OF BID.		6.  Contractor.	
			4. Next to Low- est.	5. Lowest.		
1	57	Part of Section 82, Extension of the High-level Sewer, Brookline, 78-inch by 84-inch concrete sewer in trench.	9	\$30,415 00	\$30,412 50 <sup>2</sup>	T. J. O'Connell, Boston.
2	60	Part of Section 81, Extension of the High-level Sewer, Brookline, 78-inch by 84-inch concrete sewer in trench.	9	57,450 00	56,980 00 <sup>2</sup>	Bruno & Petitti, Boston.
3	61	Part of Section 81, Extension of the High-level Sewer, Brookline, 78-inch by 84-inch concrete sewer in trench and tunnel.	5	56,690 00	53,100 00 <sup>2</sup>	Hugh Nawn Contracting Co., Boston.
4	62	Part of Section 83, Extension of the High-level Sewer, Brookline, 69-inch by 72-inch concrete sewer in tunnel.	6	59,980 00	54,672 00 <sup>2</sup>	T. J. O'Connell, Boston.
5	63	Part of Section 85, Extension of the High-level Sewer, Brighton, 69-inch by 72-inch concrete sewer in tunnel.	8	51,056 00	50,856 00 <sup>2</sup>	Geo. M. Bryne Company, Boston.
6	64	Part of Section 85, Extension of the High-level Sewer, Brighton, 69-inch by 72-inch concrete sewer in tunnel.	6	94,150 00	92,400 00 <sup>2</sup>	D. F. O'Connell Co., Boston.
7	65	Part of Section 85, Extension of the High-level Sewer, Brighton, 69-inch by 72-inch concrete sewer in tunnel.	3	71,400 00	67,450 00 <sup>2</sup>	Hugh Nawn Contracting Co., Boston.

<sup>2</sup> Contract based upon this bid.

YEAR 1907 — SEWERAGE WORKS — *Continued.**Metropolitan System — Concluded.*

7. Date of Contract.	8. Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1907.	10. Value of Work done Decem- ber 31, 1907.	
July 9, 1907,	-	For earth excavation and refill for 78 inch by 84-inch sewer in trench, \$8.75 per linear foot; for Portland cement brick masonry in manholes, \$16 per cubic yard; for Portland cement concrete masonry in trench, \$8 per cubic yard; for rock excavation in trench, \$6 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	\$30,732 61	1
Nov. 23, 1907,	-	For earth excavation and refill for 78-inch by 84-inch sewer in trench, \$9.50 per linear foot; for Portland cement brick masonry, in manholes, \$15 per cubic yard; for Portland cement masonry, in trench, \$8.50 per cubic yard; for rock excavation, in trench, \$3.50 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	-	2
Nov. 25, 1907,	-	For earth and rock excavation and refill for 78-inch by 84-inch sewer in tunnel, \$29.50 per linear foot; for earth and rock excavation and refill in trench, \$12 per linear foot; for Portland cement brick masonry in manholes and tunnel shaft, \$18 per cubic yard; for Portland cement concrete masonry in trench, \$8 per cubic yard; for Portland cement concrete masonry in tunnel, \$10 per cubic yard; for rock excavation in trench, \$4 per cubic yard; spruce lumber in trench in place, \$20 per M feet B.M.	1,760 00	3
Nov. 26, 1907,	-	For earth and rock excavation and refill for 69-inch by 72-inch sewer in tunnel, \$16.75 per linear foot; for Portland cement brick masonry in tunnel shafts, \$16 per cubic yard; for Portland cement concrete masonry in tunnel, \$10 per cubic yard; for rock excavation in tunnel, \$10 per cubic yard.	2,453 00	4
Nov. 27, 1907,	-	For rock excavation and refill for 69-inch by 72-inch sewer in tunnel, \$28 per linear foot; for Portland cement brick masonry in tunnel shafts, \$16 per cubic yard; for Portland cement concrete masonry in tunnel, \$10 per cubic yard.	-	5
Nov. 25, 1907,	-	For rock excavation and refill for 69-inch by 72-inch sewer in tunnel, \$28 per linear foot; for Portland cement brick masonry in tunnel shafts, \$20 per cubic yard; for Portland cement concrete masonry in tunnel, \$10 per cubic yard.	-	6
Nov. 25, 1907,	-	For earth and rock excavation and refill for 69-inch by 72-inch sewer in tunnel, \$30 per linear foot; for Portland cement brick masonry in tunnel shafts, \$17 per cubic yard; for Portland cement concrete masonry in tunnel, \$9 per cubic yard.	-	7



CONTRACTS MADE AND PENDING DURING THE YEAR 1907 — SEWERAGE WORKS  
— *Concluded.*

Summary of Contracts.<sup>1</sup>

	Value of Work done December 31, 1907.
North Metropolitan System, 2 contracts, . . . . .	\$43,436 25
South Metropolitan System, 12 contracts, . . . . .	195,256 84
Total of 14 contracts made and pending during the year 1907, . . . . .	\$238,693 09

<sup>1</sup> In this summary the cost of day work and contracts charged to maintenance are excluded.

## APPENDIX No. 5.

---

### FINANCIAL STATEMENT PRESENTED TO THE GENERAL COURT ON JANUARY 15, 1908.

The Metropolitan Water and Sewerage Board respectfully presents the following abstract of the account of its doings, receipts, expenditures, disbursements, assets and liabilities for the year ending November 30, 1907, in accordance with the provisions of chapter 235 of the Acts of the year 1906.

#### METROPOLITAN WATER WORKS.

The appropriations under the Metropolitan Water Acts, the receipts which are added to these appropriations, the expenditures for the construction and acquisition of works, and the balance available on December 1, 1907, have been as follows:—

Appropriations under Metropolitan Water Acts, . . . .	\$40,500,000 00
Receipts from the sales of real estate, and from labor, tools and supplies, which are placed to the credit of the Metropolitan Water Loan Fund:—	
For the year ending November 30, 1907, . . . .	\$12,410 49
For the period prior to December 1, 1906, . . . .	141,271 51
	<hr style="width: 100%; border: 0.5px solid black;"/> 153,682 00
	<hr style="width: 100%; border: 0.5px solid black;"/> \$40,653,682 00
Amount approved for payment by the Board, out of the Metropolitan Water Loan Fund:—	
For the year ending November 30, 1907, . . . .	\$195,680 06
For the period prior to December 1, 1906, . . . .	40,264,098 01
	<hr style="width: 100%; border: 0.5px solid black;"/> 40,459,778 07
Balance December 1, 1907, . . . . .	<hr style="width: 100%; border: 0.5px solid black;"/> \$193,903 93

The amount approved by the Board for maintenance and operation of the Metropolitan Water Works during the year ending November 30, 1907, was \$386,744.17.

Sums received from sales of water to municipalities not belonging to the District and to water companies, and from municipalities for admission to the District, have been applied as follows:—

For the period prior to December 1, 1906, distributed to the cities and towns of the District, as provided by section 3 of the Metropolitan Water Act, . . . . .	\$219,865 65
For the year ending November 30, 1907, applied to the Metropolitan Water Loan Sinking Fund, as provided by chapter 238, Acts of 1907, . . . . .	7,156 43
	<hr/>
	\$227,022 08

The Board has also received the following sums from rentals, land products and other sources, which, according to section 18 of the Metropolitan Water Act, are applied by the Treasurer of the Commonwealth to the payment of interest on the Metropolitan Water Loan, to sinking fund requirements, and expenses of maintenance and operation of works:—

For the year ending November 30, 1907, . . . . .	\$7,986 15
For the period prior to December 1, 1906, . . . . .	130,832 04
	<hr/>
	\$138,818 19

#### METROPOLITAN SEWERAGE WORKS.

The appropriations for the construction of the Metropolitan Sewerage Works, the receipts which are added to the appropriations, and the expenditures for construction, are given below, as follows:—

##### NORTH METROPOLITAN SYSTEM.

Appropriations under the various acts, including those for the Revere, Belmont and Malden extensions, . . . . .	\$6,160,865 73	
Receipts from sales of real estate and from miscellaneous sources, which are placed to the credit of the North Metropolitan System:—		
For the year ending November 30, 1907, . . . . .	—	
For the period prior to December 1, 1906, . . . . .	17,153 40	
Amount approved for payment by the Board <sup>1</sup> out of the Metropolitan Sewerage Loan Fund, North System:—		
For the year ending November 30, 1907, . . . . .	—	\$17,437 95
For the period prior to December 1, 1906, . . . . .	—	6,128,585 21
	<hr/>	<hr/>
	\$6,178,019 13	\$6,146,023 16
Balance North Metropolitan System Dec. 1, 1907, . . . . .		\$31,995 97

<sup>1</sup> The word "Board" refers to the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board.

## SOUTH METROPOLITAN SYSTEM.

*Charles River Valley Sewer.*

Appropriations under the various acts, . . . . .	\$800,046	27
Amount approved by the Metropolitan Sewerage Commission for payment on account of the Charles River Valley Sewer, . . . . .	-	\$800,046 27

*Neponset Valley Sewer.*

Appropriations under the various acts, . . . . .	\$904,000	00
Receipts for pumping, which are placed to the credit of the South Metropolitan System, . . . . .	109	50
Amount approved by the Board for payment on account of the Neponset Valley Sewer: —		
For the year ending November 30, 1907, . . . . .	-	-
For the period prior to December 1, 1906, . . . . .	-	911,531 46

*High-level Sewer and Extension.*

Appropriations under the various acts, . . . . .	\$7,163,000	00
Receipts from sales of real estate and from miscellaneous sources, which are placed to the credit of the South Metropolitan System: —		
For the year ending November 30, 1907, . . . . .	474	28
For the period prior to December 1, 1906, . . . . .	6,768	97
Amount approved by the Board for payments on account of the High-level Sewer and Extension: —		
For the year ending November 30, 1907, . . . . .	-	478,342 78
For the period prior to December 1, 1906, . . . . .	-	5,961,235 24
	\$8,874,399 02	\$8,151,155 75
Balance, South Metropolitan System, Dec. 1, 1907, . . . . .		\$723,243 27

For the maintenance and operation of sewerage works annual appropriations are made. The balances, appropriations and expenditures for the year ending November 30, 1907, are as follows: —

## MAINTENANCE OF NORTH METROPOLITAN SYSTEM.

Appropriated for the year ending November 30, 1907, . . . . .	\$143,000	00
Receipts from pumping and from other sources, which are returned to the appropriation: —		
For the year ending November 30, 1907, . . . . .	1,220	54
	\$144,220	54
Amount approved for payment by the Board: —		
For the year ending November 30, 1907, . . . . .	136,641	74
Balance December 1, 1907, . . . . .		\$7,578 80

## MAINTENANCE OF SOUTH METROPOLITAN SYSTEM.

Appropriated for the year ending Nov. 30, 1907, . . . . .	\$100,500 00
Receipts from sales of property and for pumping, which are re- turned to the appropriation:—	
For the year ending November 30, 1907, . . . . .	12 30
	<hr/>
	\$100,512 30
Amount approved for payment by the Board:—	
For the year ending November 30, 1907, . . . . .	96,157 34
	<hr/>
Balance December 1, 1907, . . . . .	\$4,354 96

## APPENDIX No. 6.

### LEGISLATION OF THE YEAR 1907 AFFECTING THE METROPOLITAN WATER AND SEWERAGE BOARD.

#### ACTS OF 1907

[CHAPTER 165.]

#### AN ACT RELATIVE TO ASSESSMENTS FOR THE MAINTENANCE OF THE METROPOLITAN PARK, SEWER AND WATER DISTRICTS.

*Be it enacted, etc., as follows:*

SECTION 1. Annual appropriations shall be made for the maintenance of parks and boulevards under the charge of the metropolitan park commission, and for the maintenance of the north and south metropolitan systems of sewerage, and for the maintenance of the metropolitan water system under the control of the metropolitan water and sewerage board, and such appropriations shall be apportioned and assessed by the treasurer and receiver general in the manner now provided by law.

Annual appropriation to be made for the maintenance of parks, etc., the metropolitan water system and the metropolitan sewerage system.

SECTION 2. Of the amount so assessed and collected, any balance remaining on the thirtieth day of November in any year shall be carried forward to the next year, and shall be taken into account in making the assessments for that year.

Balance remaining to be carried to account of succeeding year.

SECTION 3. All acts and parts of acts inconsistent with this act are hereby repealed.

Repeal.

SECTION 4. This act shall take effect upon its passage.  
[Approved March 4, 1907.]

[CHAPTER 172.]

#### AN ACT TO APPROVE THE PURCHASE BY THE UNITED STATES OF AMERICA OF A TRACT OF LAND ON DEER ISLAND, IN BOSTON HARBOR, AND TO CEDE JURISDICTION OVER THE SAME TO THE GENERAL GOVERNMENT.

*Be it enacted, etc., as follows:*

SECTION 1. The consent of the Commonwealth of Massachusetts is hereby granted to the United States of America

The United States may acquire a certain



tract of land on Deer Island in Boston harbor.

to the purchase, for fortification purposes, from the city of Boston, of a certain tract of land on Deer Island in Boston harbor, containing a total area of about one hundred acres above mean low water mark; the said tract being marked on the grounds by certain monuments, and being designated on a map entitled "Plan showing land at Deer Island, Boston Harbor, Mass., acquired by the United States under provisions of Act of Congress approved June 25th, 1906", dated United States Engineer Office, Boston, Massachusetts, September twenty-nine, nineteen hundred and six, and signed by Edw. Burr, major, corps of engineers; a copy of said plan with a copy of the deed of conveyance to the United States of the aforesaid land being recorded in Suffolk registry of deeds, book 3177, page 577.

Jurisdiction ceded, including two strips of land acquired by Commonwealth for sewerage system.

SECTION 2. Jurisdiction over the tract so purchased, including jurisdiction over the two strips of land lying within the tract described in section one, which were acquired by the Commonwealth of Massachusetts under a taking made by the board of metropolitan sewerage commissioners, dated April 2, 1890, and recorded with Suffolk deeds, book 1928, page 42, the said two strips being the fifth and sixth parcels described in said taking, is hereby ceded to the United States of America: *provided*, and the cession and consent aforesaid are given upon the express condition that the Commonwealth shall retain concurrent jurisdiction with the United States in and over the lands so purchased, as well as in and over the aforesaid two strips of land lying within the tract described in section one, so far as that all civil processes and such criminal processes as may issue under authority of the Commonwealth against any person or persons charged with crimes committed without the said tract of land, including also the two strips of land aforesaid, may be executed thereon, in the same manner as though this cession and consent had not been granted.

Provided Commonwealth retain concurrent jurisdiction.

Certain flats may be occupied and filled.

SECTION 3. The United States government is hereby authorized, upon such terms and conditions as may be prescribed by the harbor and land commissioners, to occupy and fill such flats belonging to the Commonwealth, and to place such structures in or over the tide water adjacent to the area herein authorized to be purchased as may be necessary for the purposes for which said area is to be used.

SECTION 4. This act shall be void unless a suitable plan or plans of the premises purchased by the United States under the provisions of this act shall be deposited in the office of the secretary of the Commonwealth within one year after its passage.

Plans to be deposited with the secretary of the Commonwealth.

SECTION 5. Nothing contained herein shall abridge or affect the right and title of the Commonwealth in and to the two strips of land included in the tract described in section one, and acquired under the taking aforesaid by the board of metropolitan sewerage commissioners, the said two strips being the fifth and sixth parcels described in said taking.

Certain rights of the Commonwealth not abridged.

SECTION 6. This act shall take effect upon its passage.  
[Approved March 6, 1907.]

---

[CHAPTER 200.]

AN ACT MAKING AN APPROPRIATION FOR OPERATING THE  
SOUTH METROPOLITAN SYSTEM OF SEWAGE DISPOSAL.

*Be it enacted, etc., as follows:*

SECTION 1. A sum not exceeding one hundred thousand five hundred dollars is hereby appropriated, to be paid out of the South Metropolitan System Maintenance Fund, for the cost of maintenance and operation of the south metropolitan system of sewage disposal, comprising a part of Boston, the cities of Newton and Waltham, and the towns of Brookline, Watertown, Dedham, Hyde Park and Milton, during the fiscal year ending on the thirtieth day of November, nineteen hundred and seven.

South metropolitan system of sewage disposal.

SECTION 2. This act shall take effect upon its passage.  
[Approved March 14, 1907.]

---

[CHAPTER 201.]

AN ACT MAKING AN APPROPRIATION FOR OPERATING THE  
NORTH METROPOLITAN SYSTEM OF SEWAGE DISPOSAL.

*Be it enacted, etc., as follows:*

SECTION 1. A sum not exceeding one hundred and forty-three thousand dollars is hereby appropriated, to be paid out of the North Metropolitan System Maintenance Fund, for the

North metropolitan system of sewage disposal.

maintenance and operation of the system of sewage disposal for the cities and towns included in what is known as the north metropolitan system, during the fiscal year ending on the thirtieth day of November, nineteen hundred and seven.

SECTION 2. This act shall take effect upon its passage.  
[Approved March 14, 1907.]

---

[CHAPTER 238.]

AN ACT RELATIVE TO THE DISPOSITION OF MONEY RECEIVED  
FOR WATER FURNISHED OUTSIDE OF THE METROPOLITAN DISTRICT  
BY THE METROPOLITAN WATER AND SEWERAGE BOARD.

*Be it enacted, etc., as follows:*

Disposition of money received for water outside of the metropolitan district, etc.

SECTION 1. All sums of money which shall be paid into the treasury of the Commonwealth by any city or town not belonging to the metropolitan water district, or by a water company in any such city or town, for water furnished under the provisions of section three of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, and acts in amendment thereof, shall hereafter be applied by the treasurer and receiver general to the sinking fund established for the payment of bonds issued on account of the metropolitan water district.

SECTION 2. This act shall take effect upon its passage.  
[Approved March 22, 1907.]

---

[CHAPTER 269.]

AN ACT RELATIVE TO THE HOURS OF LABOR OF WORKMEN,  
MECHANICS AND ENGINEERS.

*Be it enacted, etc., as follows:*

1906, 517, § 1,  
amended.

SECTION 1. Section one of chapter five hundred and seventeen of the acts of the year nineteen hundred and six is hereby amended by inserting after the word "Laws", in the sixth line, the following:—No laborer, workman or mechanic so employed shall be requested or required to work more than eight hours in any one calendar day or more than forty-eight hours in any one week except in cases of extraordinary emergency. Only a case of danger to property, to life, to public safety or to public health shall be considered a case of ex-

traordinary emergency within the meaning of this section. Engineers shall be considered mechanics within the meaning of this act, — and by adding at the end of the section the words: — Threat of loss of employment or threat to obstruct or prevent the obtaining of employment, or threat to refrain from employing in the future shall be considered requiring, within the meaning of this section, — so as to read as follows: — *Section 1.* Eight hours shall constitute a day's work for all laborers, workmen and mechanics now or hereafter employed by or on behalf of the Commonwealth, or of any county therein, or of any city or town which has accepted the provisions of section twenty of chapter one hundred and six of the Revised Laws. No laborer, workman or mechanic so employed shall be requested or required to work more than eight hours in any one calendar day or more than forty-eight hours in any one week except in cases of extraordinary emergency. Only a case of danger to property, to life, to public safety or to public health shall be considered a case of extraordinary emergency within the meaning of this section. Engineers shall be considered mechanics within the meaning of this act. But in cases where a Saturday half-holiday is given the hours of labor upon the other working days of the week may be increased sufficiently to make a total of forty-eight hours for the week's work. Threat of loss of employment or threat to obstruct or prevent the obtaining of employment, or threat to refrain from employing in the future shall be considered requiring, within the meaning of this section.

Eight hours  
to constitute a  
day's work for  
public em-  
ployees, etc.

SECTION 2. Section two of said chapter five hundred and seventeen is hereby amended by inserting after the word "mechanic", in the eighth line, the words: — working within this Commonwealth, — and by inserting after the word "be", in the eleventh line, the words: — requested or, — and by adding at the end of the section the words: — and every such contract which does not contain this stipulation shall be null and void, — so as to read as follows: — *Section 2.* Every contract, excluding contracts for the purchase of material or supplies, to which the Commonwealth, or of any county therein, or of any city or town which has accepted the provisions of section twenty of chapter one hundred and six of the Revised Laws, is a party which may involve the employment of laborers, workmen or mechanics shall contain a stipu-

1906, 517, § 2,  
amended.

Contracts void  
if they do not  
contain eight  
hour provision.

lation that no laborer, workman or mechanic working within this Commonwealth in the employ of the contractor, subcontractor or other person doing or contracting to do the whole or a part of the work contemplated by the contract shall be requested or required to work more than eight hours in any one calendar day and every such contract which does not contain this stipulation shall be null and void.

1906, 517, § 4,  
amended.

SECTION 3. Section four of said chapter five hundred and seventeen is hereby amended by inserting before the word "Any", in the first line, the words:— Any person or contractor or subcontractor, or any agent or person acting on behalf of any contractor or subcontractor, or, — so as to read as follows:— *Section 4.* Any person or contractor or subcontractor, or any agent or person acting on behalf of any contractor or subcontractor, or any agent or official of the Commonwealth or of any county, city or town who violates any provision of this act shall be subject to a penalty of fifty dollars for each offence. [*Approved April 3, 1907.*]

Penalty.

---

[CHAPTER 349.]

AN ACT RELATIVE TO SUPPLYING CERTAIN CITIES AND TOWNS  
WITH WATER FROM THE METROPOLITAN WATER SYSTEM.

*Be it enacted, etc., as follows:*

1895, 488, § 3,  
etc., amended.

SECTION 1. Section three of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, as amended by chapter three hundred and ninety-two of the acts of the year eighteen hundred and ninety-eight, and by chapter three hundred and forty-nine of the acts of the year eighteen hundred and ninety-nine, is hereby further amended by inserting after the word "and", in the twenty-seventh line, the words:— in case of fire or other emergency, — and by striking out the word "other", in the twenty-eighth line, — so as to read as follows:— *Section 3.* Said board, acting for the Commonwealth, shall construct, maintain and operate a system of metropolitan water works substantially in accordance with the plans and recommendations of the state board of health, contained in their report to the legislature of the year eighteen hundred and ninety-five, and shall provide thereby a sufficient supply of pure

To construct,  
etc., a system  
of metropoli-  
tan water  
works, etc.



water for the following named cities and towns, and the inhabitants thereof, to wit:—The cities of Boston, Chelsea, Everett, Malden, Medford, Newton and Somerville, and the towns of Belmont, Hyde Park, Melrose, Revere, Watertown and Winthrop, which cities and towns shall constitute the Metropolitan Water District; shall secure and protect the purity of said water; shall on application furnish water to any city or town aforesaid that at the time of application owns its water pipe system; shall on application admit any other city or town, any part of which is within ten miles of the state house, into said water district, and furnish water to the same on the terms prescribed by this act for the cities and towns aforesaid, and on such payment of money as said board may determine; shall on application furnish water to any water company owning the water pipe system in any town within said ten miles, on such water company assuming the assessments of the town, if any, and making such payment of money as said board may determine; and in case of fire or other emergency may from time to time furnish water to any city, town or water company, on such payment of money as said board may determine: *provided*, that any such city or town last referred to shall first have acquired the works of any water company therein situated, constructed for the purpose of supplying said city or town or its inhabitants with water. All payments of money aforesaid shall be distributed to the cities and towns in said district in proportion to the total amount of the annual assessments theretofore paid by them respectively. Said board shall furnish said water to the city, town or company, by delivering the same into a main water pipe, reservoir or tank of the city, town or company, under sufficient pressure for use without local pumping, unless delivered in some other manner by mutual agreement between the parties interested; and shall have the direction and control of the connections between the metropolitan and local systems. Said board may utilize the fall of water at any dam under their charge, and may thereby produce power or electricity, and may transmit such power or electricity by pipes, wires or other suitable means, and sell the same, or the right to use such water, by written or other contract, to run for a term not exceeding fifteen years. Any person or corporation authorized by said board shall have all

Metropolitan  
Water District.

Certain other  
cities and  
towns may be  
admitted.

Water may be  
supplied in  
case of  
emergency.

Proviso.



the powers relating to the production, sale and transmission of power and electricity given by this act to said board.

SECTION 2. This act shall take effect upon its passage.  
[Approved May 3, 1907.]

---

[CHAPTER 458.]

AN ACT RELATIVE TO THE RETIREMENT OF CERTAIN VETERANS  
IN THE SERVICE OF THE COMMONWEALTH.

*Be it enacted, etc., as follows:*

Retirement of  
certain veter-  
ans of the  
civil war.

Proviso.

SECTION 1. A veteran of the civil war in the service of the Commonwealth, if incapacitated for active duty, shall be retired from active service, with the consent of the governor, at one half the rate of compensation paid to him when in active service, to be paid out of the treasury of the Commonwealth: *provided*, that no veteran shall be entitled to be retired under the provisions of this act unless he shall have been in the service of the Commonwealth at least ten years. But if, in the opinion of the governor and council, any veteran of the civil war in said service is incapacitated to such a degree as to render his retirement necessary for the good of the service, he may so be retired at any time. A veteran retired under the provisions of this act, whose term of service was for a fixed number of years, shall be entitled to the benefits of the act without reappointment.

SECTION 2. This act shall take effect upon its passage.  
[Approved May 28, 1907.]

---

[CHAPTER 464.]

AN ACT RELATIVE TO THE CONSTRUCTION OF SEWERS AND  
DRAINS BY CERTAIN CITIES AND TOWNS.

*Be it enacted, etc., as follows:*

1903, 383, § 3,  
amended.

Boston ex-  
cepted in pro-  
vision relative  
to expending  
certain per cent  
of valuation  
for new sewers,  
etc.

SECTION 1. Section three of chapter three hundred and eighty-three of the acts of the year nineteen hundred and three is hereby amended by inserting after the word "town", in the first line, the words:—except the city of Boston,—so as to read as follows:—*Section 3.* Any city or town, except the city of Boston, using any metropolitan sewer may, in any year, and shall in any year specified by the officer or board having charge of said sewers, expend one twentieth of

one per cent of its taxable valuation, to be met by loan outside the debt limit, in the construction, in connection with said sewers, of branch intercepting sewers, connections of existing sewers with intercepting sewers, branch drains, sewers, or drains in any street where one thereof only shall have been built, and the necessary connections aforesaid.

SECTION 2. This act shall take effect upon its passage.  
[Approved May 29, 1907.]

---

[CHAPTER 467.]

AN ACT TO AUTHORIZE THE STATE BOARD OF HEALTH TO DELEGATE CERTAIN AUTHORITY TO BOARDS OF HEALTH, WATER BOARDS AND WATER COMMISSIONERS IN CITIES AND TOWNS.

*Be it enacted, etc., as follows:*

SECTION 1. Section one hundred and thirteen of chapter seventy-five of the Revised Laws is hereby amended by adding thereto the following:—Said board may delegate the granting and withholding of any permit required by such rules or regulations to state boards and commissions and to selectmen in towns and to boards of health, water boards and water commissioners in cities and towns, to be exercised by such selectmen, boards and commissions, subject to such recommendation and direction as shall be given from time to time by the state board of health; and upon complaint of any person interested said board shall investigate the granting or withholding of any such permit and make such orders relative thereto as it may deem necessary for the protection of the public health,—so as to read as follows:—*Section 113.* Said board may cause examinations of such waters to be made to ascertain their purity and fitness for domestic use or their liability to impair the interests of the public or of persons lawfully using them or to imperil the public health. It may make rules and regulations to prevent the pollution and to secure the sanitary protection, of all such waters as are used as sources of water supply. Said board may delegate the granting and withholding of any permit required by such rules or regulations to state boards and commissions and to selectmen in towns and to boards of health, water boards and water commissioners in cities and towns, to be exercised by such selectmen, boards and commissions, subject to such rec-

R. L. 75, § 113,  
amended.

State board of  
health may  
delegate to  
state commis-  
sions, etc., the  
granting, etc.,  
of permits.

ommendation and direction as shall be given from time to time by the state board of health; and upon complaint of any person interested said board shall investigate the granting or withholding of any such permit and make such orders relative thereto as it may deem necessary for the protection of the public health.

SECTION 2. This act shall take effect upon its passage.  
[Approved May 29, 1907.]

---

[CHAPTER 524.]

AN ACT TO PREVENT WASTE OF WATER IN CITIES AND TOWNS  
SUPPLIED FROM THE SOURCES OR WORKS OF THE METRO-  
POLITAN WATER DISTRICT.

*Be it enacted, etc., as follows:*

Certain cities  
and towns to  
equip water  
service with  
meters, etc.

SECTION 1. All cities, towns, districts or corporations which derive all or any part of their water supply from the metropolitan water works or from sources used by or under the control of the metropolitan water district shall after December thirty-first, nineteen hundred and seven, equip with water meters all water services thereafter installed for them, and shall also annually equip with water meters five per cent of the water services which were unmetered on December thirty-first, nineteen hundred and seven; and shall also thereafter charge each consumer in proportion to the amount of water used: *provided*, that no city, town or district shall, in any one year, contract for more than the number of meters to be installed by it during that year under the provisions of this act; and *provided, also*, that a minimum rate may be fixed for which the consumer shall be entitled to a stated quantity of water.

Provisos.

How provi-  
sions of act  
shall apply.

SECTION 2. The provisions of this act shall not apply to the water service for fire purposes only of any city, town, fire district or individual, nor shall such service be taken into consideration in computing metered water service. All water used for the supply of public buildings or other premises under the control of a city, town or district, and all water used from the public works for the flushing of sewers, watering of streets and all other purposes, except for the extinguishment of fires, may be paid for by the city, town or district.

SECTION 3. Meters shall receive the necessary care and maintenance to secure proper efficiency and shall be tested or replaced by the city, town, district or water company whenever there is reason to believe that the records furnished by them are inaccurate, or whenever the service furnished is in other respects inefficient. Cities, towns, districts and corporations may make rules and regulations relative to the care, maintenance and protection of meters, and for properly ascertaining and recording the amount of water actually used during specified periods by each water consumer. Proceedings for the enforcement of this act shall be instituted and prosecuted by the attorney-general upon complaint of any party in interest.

Care and maintenance of meters, etc.

Proceedings for enforcement.

SECTION 4. This act shall take effect upon its passage.  
[Approved June 15, 1907.]

---

[CHAPTER 570.]

AN ACT RELATIVE TO THE HOURS OF LABOR OF LABORERS,  
WORKMEN AND MECHANICS.

*Be it enacted, etc., as follows:*

SECTION 1. Section one of chapter five hundred and seventeen of the acts of the year nineteen hundred and six, as amended by section one of chapter two hundred and sixty-nine of the acts of the year nineteen hundred and seven, is hereby further amended by striking out the word "Saturday", in the thirteenth line, and inserting in place thereof the word:—weekly,—and by adding at the end of the section the words:—This section shall not apply to persons employed in any state, county or municipal institution, on the farm, or in the care of the grounds, in the stable, in the domestic or kitchen and dining-room service, or in store-rooms and offices,—so as to read as follows:—*Section 1.* Eight hours shall constitute a day's work for all laborers, workmen and mechanics now or hereafter employed by or on behalf of the Commonwealth, or of any county therein, or of any city or town which has accepted the provisions of section twenty of chapter one hundred and six of the Revised Laws. No laborer, workman or mechanic so employed shall be requested or required to work more than eight hours in any one calendar day or more than forty-eight hours in any one

1906, 517, § 1,  
etc., amended.

Eight hours to  
constitute a  
day's work for  
public em-  
ployees, etc.

week except in cases of extraordinary emergency. Only a case of danger to property, to life, to public safety or to public health shall be considered a case of extraordinary emergency within the meaning of this section. Engineers shall be considered mechanics within the meaning of this act. But in cases where a weekly half-holiday is given the hours of labor upon the other working days of the week may be increased sufficiently to make a total of forty-eight hours for the week's work. Threat of loss of employment or threat to obstruct or prevent the obtaining of employment, or threat to refrain from employing in the future shall be considered requiring, within the meaning of this section. This section shall not apply to persons employed in any state, county or municipal institution, on the farm, or in the care of the grounds, in the stable, in the domestic or kitchen and dining-room service, or in storerooms and offices.

SECTION 2. This act shall take effect upon its passage.  
[*Approved June 28, 1907.*]

---

[CHAPTER 575.]

AN ACT TO AUTHORIZE THE METROPOLITAN WATER AND SEWERAGE BOARD TO SELL CERTAIN PROPERTY FOR THE WIDENING OF A RAILROAD IN THE TOWN OF NATICK.

*Be it enacted, etc., as follows:*

Metropolitan water and sewerage board may sell land in Natick to widen, etc., the railroad location.

SECTION 1. The metropolitan water and sewerage board may, in its discretion sell, by public or private sale, any property of the Commonwealth held and used for water supply purposes, situated in the town of Natick on both sides of and abutting on the Boston and Albany railroad, whether taken by the Commonwealth by eminent domain or otherwise, if such property is deemed necessary for the alteration, relocation or widening of said railroad and is not deemed necessary by said board for other public purposes.

SECTION 2. This act shall take effect upon its passage.  
[*Approved June 28, 1907.*]

## [CHAPTER 577.]

## AN ACT TO PROVIDE FOR ONE DAY'S REST IN SEVEN.

*Be it enacted, etc., as follows:*

SECTION 1. Except in cases of emergency or except at the request of the employee, it shall not be lawful for any person, partnership, association or corporation to require an employee engaged in any commercial occupation, or in the work of any industrial process, or in the work of transportation or communication, to do on the Lord's day the usual work of his occupation, unless such employee is allowed during the six days next ensuing twenty-four consecutive hours without labor.

Employees to be allowed one day's rest in seven.

SECTION 2. This act shall not be construed as authorizing any work on the Lord's day not now authorized by law; nor as applying to farm or personal service, to druggists, to watchmen, to superintendents or managers, to janitors, or to persons engaged in the transportation, sale or delivery of milk, food or newspapers.

Relative to work authorized.

SECTION 3. Whoever violates the provisions of this act shall be punished by a fine of not more than fifty dollars for each offence.

Penalty.

SECTION 4. This act shall take effect on the first day of October in the year nineteen hundred and seven. [*Approved June 28, 1907.*]





# ARTHUR D. BUZBY, C. E.

## INDEX TO LEGISLATION OF THE YEAR 1907

AFFECTING THE

### METROPOLITAN WATER AND SEWERAGE BOARD.

#### A.

##### APPROPRIATIONS.

	Chap.	Sect.
annnal, for sewer and water systems, to be made, . . . . .	165	1
North Metropolitan System of sewage disposal, for maintenance of, . . .	201	1
South Metropolitan System of sewage disposal, for maintenance of, . . .	200	1

#### B.

##### BOSTON.

sewer construction in, excepted from, relative to, . . . . .	464	1
--	-----	---

#### C.

##### CONTRACTOR.

liable for violation of labor statute, . . . . .	269	2
--	-----	---

##### CONTRACTS.

to contain provisions of statute, otherwise void, . . . . .	269	2
---	-----	---

#### D.

##### DEER ISLAND.

relative to jurisdiction of land of Commonwealth on, . . . . .	172	2
--	-----	---

#### E.

##### EMERGENCY.

under labor statute, defined, . . . . .	269	1
---	-----	---

##### EMPLOYEES.

certain, in state, county or municipal institutions not included in labor statute,	570	1
not to be requested or required to work more than eight hours a day except		
in emergency, . . . . .	269	1
shall not be employed on Lord's day except in emergency and unless allowed		
other time, . . . . .	577	1

#### H.

##### HOURS OF LABOR.

no employee to be requested or required to work more than eight hours a day		
except in emergency, . . . . .	269	1

#### L.

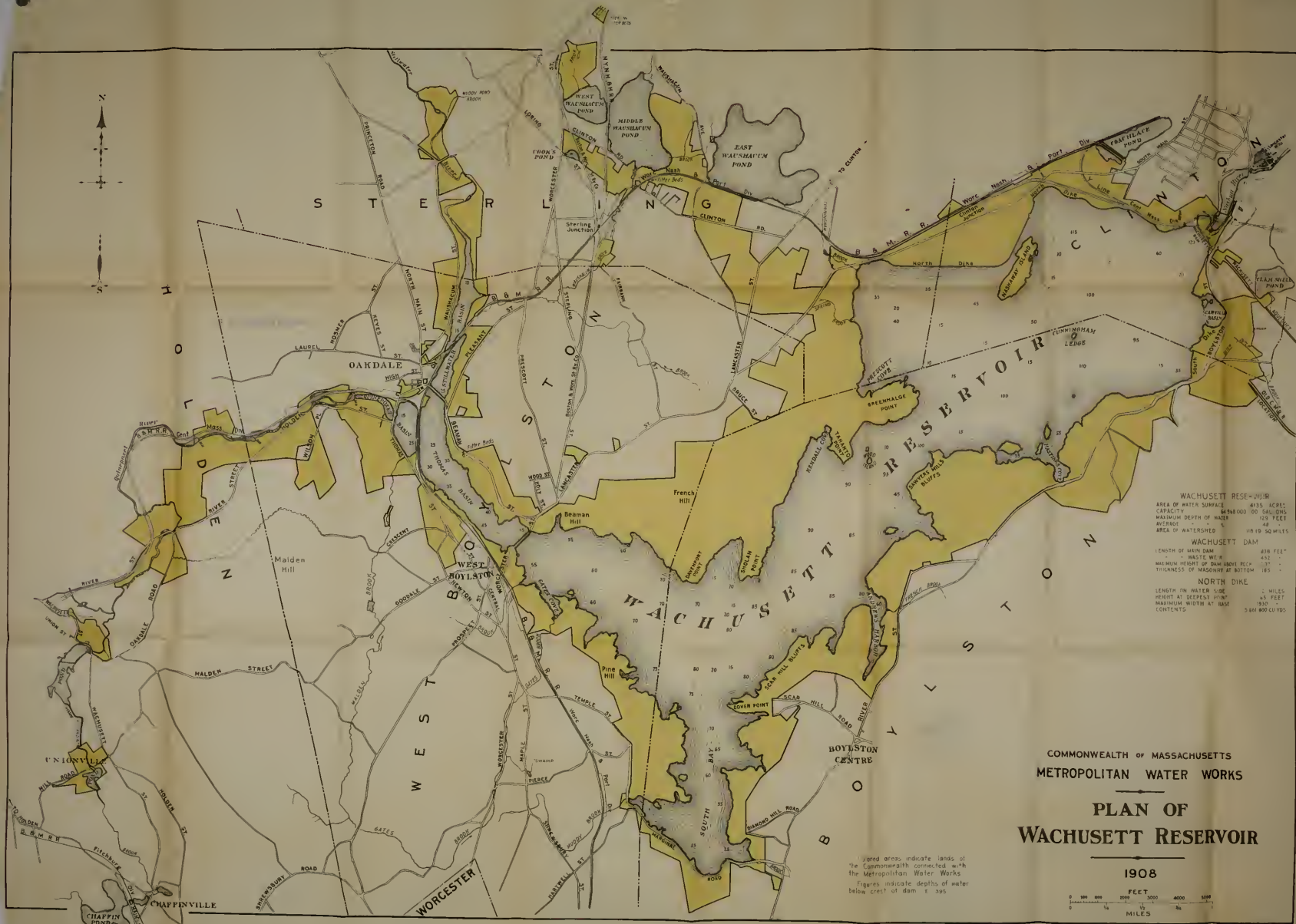
##### LORD'S DAY.

relative to work on, . . . . .	577	1, 2
--------------------------------	-----	------

<b>M.</b>		Chap.	Sect.
<b>METERS.</b>			
installation of, required in Metropolitan District,		524	1
<b>METROPOLITAN WATER ACT.</b>			
permitting Board to furnish water inside of ten-mile limit in emergency,		349	1
<b>METROPOLITAN WATER AND SEWERAGE BOARD.</b>			
may sell land in Natick,		575	1
<b>N.</b>			
<b>NATICK.</b>			
certain land in, Board may sell,		575	1
<b>NORTH METROPOLITAN SYSTEM OF SEWAGE DISPOSAL.</b>			
appropriation for maintenance of,		201	1
<b>P.</b>			
<b>PERMITS.</b>			
State Board of Health may delegate granting of, under its rules,		467	1
<b>S.</b>			
<b>SEWERS.</b>			
Boston excepted from construction of certain, relative to,		464	1
<b>SOUTH METROPOLITAN SYSTEM OF SEWAGE DISPOSAL.</b>			
appropriation for maintenance of,		200	1
<b>STATE BOARD OF HEALTH.</b>			
may delegate granting of permits under rules and regulations to State boards,		467	1
<b>V.</b>			
<b>VETERANS.</b>			
relative to retirement of certain, on half pay,		458	1
<b>W.</b>			
<b>WATER.</b>			
Board may furnish to cities, towns, or water companies inside of ten-mile limit in emergency,		349	1
furnished outside of Metropolitan District, sums for, payable to sinking fund,		238	1
installation of meters, to prevent waste of,		524	1

ARTHUR D. BUZBY, C. E.







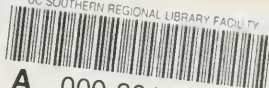


ARTHUR D. BUZBY, C. E.

UNIVERSITY of CALIFORNIA  
AT  
LOS ANGELES  
LIBRARY

ARTHUR D. BUZE

UC SOUTHERN REGIONAL LIBRARY FACILITY



A 000 391 955 2

